The interplay of object animacy and verb class in representation building

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Anna Czypionka

Präsident/Präsidentin der Humboldt-Universität zu Berlin
Prof. Dr. Jan-Hendrik Olbertz

Dekanin/Dekan der Philosophischen Fakultät II
Prof. Dr. Helga Schwalm

Gutachterinnen/Gutachter:

1. Katharina Spalek

2. Manfred Krifka

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Abstract

During the comprehension of transitive sentences, the parser uses different kinds of information like word order, the arguments' animacy status and case marking to build a representation of the situation the sentence describes. Previous research in psycholinguistics has shown that two animate arguments in a sentence cause additional processing costs, unless other cues allow the assignment of grammatical and thematic roles to the arguments. In case-marking languages like German, one of these cues is morphological case marking. While most German verbs assign the canonical nominative-accusative case pattern to their arguments, a small group of verbs assign noncanonical nominative-dative. These verbs differ from standard transitive verbs both in their syntax and their semantics, and are known to cause higher processing cost during comprehension.

This dissertation examines how the processing of argument animacy contrasts during sentence comprehension is modulated by the verbal case marking pattern. I report the results of four different experiments, using self-paced reading time measurements, eyetracking and ERP measurements. All experimental methods show that the effect of argument animacy contrasts interacts with the effects of the verbal case marking pattern. The findings add further details to the existing knowledge about sentence comprehension, and combine perspectives on transitivity from theoretical linguistics and psycholinguistics.

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Chapter 1

Introduction

A transitive situation is a situation with at least two participants involved in an action or event. This kind of situation is linguistically coded in a transitive sentence, like *Peter is kicking the table*, with a verb (*to kick*) that denotes the event, and its arguments (*Peter* and *the table*) which denote the participants in the event.

A central question in psycholinguistic research is how the parser assigns grammatical and thematic roles to the participants. How does it decide which participant is the grammatical subject and which is the grammatical object? How does it build a representation of who does what to whom in the event described in the sentence, and which linguistic cues are these decisions based on? A well-known strategy for this in the comprehension of transitive sentences is the use of animacy contrasts. This means that a sentence describing an animate participant (like *Peter*) doing something to an inanimate participant (like *the table*) is easier to process than a sentence with two animate participants (e.g., Frisch and Schlesewsky, 2001; Grewe et al., 2007; Trueswell et al., 1994; Weckerly and Kutas, 1999).

In this dissertation, I present research on the use of animacy contrasts in the comprehension of German transitive sentences. To better understand the interplay of different types of information during sentence comprehension, I combine a variation in object animacy with a variation in verb class, using verbs that assign either accusative or dative to their single objects. I propose the hypothesis that the use of animacy contrasts is modulated by the verb class, signaled by the verbal

case marking pattern. I will present the results of four experiments, showing an interplay between object animacy and verb class during sentence comprehension.

In the Introduction, I will present two different definitions of a prototypically transitive situation, and deviations from both definitions of prototypical transitivity. The first definition is based on the animacy of the arguments in the transitive sentence. The second definition is based on the semantic and syntactic behaviour of the verb. I will then illustrate how deviations from both kinds of prototypical transitivity are reflected in the structure of nonprototypically transitive sentences. I will also present previous psycholinguistic studies which show that deviations from both kinds of prototypical transitivity lead to increased processing costs for these sentences. I will then propose the hypothesis that motivates my own research, and will make predictions for how the combinations of different deviations from prototypical transitivity will influence processing. Chapter 2 will be dedicated to a detailed explanation of the Language Material that I used as stimulus sentences in the experiments presented here.

In Chapters 3 to 5, I will present the results of the experiments I performed in order to test my hypothesis. Each of these experimental Chapters is dedicated to one experimental method, and will offer a discussion of the results of the respective experiment and a comparison of these results to the sentence processing literature using a comparable psycholinguistic method.

In the General Discussion (Chapter 6), I will compare the results of all my experiments presented in the preceding Chapters. I will discuss the different timecourses of the effects gained with different methods. I will also offer some possible linguistic explanations for the interactions between animacy and verb class, based on different linguistic processes.

1.1 Noncanonical arguments

1.1.1 Theoretical aspects of noncanonical arguments

In typological research, it is assumed that the prototypical, most 'normal' or natural transitive sentences in the languages of the world are the ones with an animate grammatical subject doing something to an inanimate grammatical object.

Comrie (1989) gives the following description of the most natural transitive construction: "In the transitive construction, there is an information flow that involves two entities, the A [agent] and the P [patient]. Although in principle either of A and P can be either animate or definite, it has been noted than in actual discourse there is a strong tendency for the information flow from A to P to correlate with an information flow from more to less animate and from more to less definite. In other words, the most natural kind of transitive construction is one where the A is high in animacy and definiteness, and the P is lower in animay and definiteness; and any deviation from this pattern leads to a more marked construction. This has implications for a functional approach to case marking: the construction which is more marked in terms of the direction of information flow should also be more marked formally, i.e. we would expect languages to have some special device to indicate that the A is low in animacy or definiteness or that the P is high in animacy or definiteness." (Comrie, 1989, p. 128)

This generalisation is supported by observations from many different languages. In languages where case marking or agreement patterns are influenced by animacy, simpler linguistic forms are used to mark the less marked arguments (i.e., less marked with respect to animacy in combination with the specific grammatical role). A well-known example is Differential Object Marking (DOM, Bossong, 1985, 1991). In DOM languages, animate objects usually require a special case marker, while inanimate objects are not marked.

Næss (2004) reviews Differential Object Marking in a variety of languages. Naess argues that the unusual property of the object that is marked is not its animacy, but rather its *affectedness*[1]. This semantic property is strongly linked

[1]Næss (2004, p. 1203): "The tendency to case-mark objects that are high in definiteness

to animacy, but the two are not identical. Unlike animacy, the affectedness of an argument's referent can also be different depending on the situation described in different transitive sentences. Other examples for the special marking of the arguments depending on their animacy include split ergativity (Silverstein, 1976) and subject marking (Dixon, 1994). Reviewing differential case marking patterns in a variety of languages, Malchukov (2008) concludes that differential case marking is used to distinguish subjects from objects, but also to mark thematic roles like *agent* and *patient*, the specific function depending on the language. Findings in corpus linguistics support this animacy-based aspect of prototypical transitivity, showing that in informal speech, the majority of transitive clauses have animate subjects and inanimate objects (Jäger, 2004). Research on Swedish corpora has shown that in spoken transitive sentences, an average of 92% have animate 'agent' subject, while an average of 91% of the nonreflexive direct objects are inanimate (and only 9% animate) (Dahl, 2008).

The evidence cited above shows that animate subjects followed by inanimate objects indeed seem to represent the most natural kind of transitive construction. This makes these constructions the ones that speakers produce, and hearers comprehend, most often.

1.1.2 Processing noncanonical arguments

In psycholinguistics, animacy contrasts are known to be an important cue in the processing of transitive sentences. A number of studies in sentence comprehension and production research investigate the processing of argument animacy. Usually, in these studies, sentences with animate subject-agents and inanimate object-patients are chosen as the baseline condition, based on the explicit or implicit assumption that this distribution of animacy is the prototypical one that is easiest to process. This assumption has been justified in a number of studies, and deviations from this prototypical distribution of animacy are known to affect

and animacy is in fact a reflection of the accusative case as marking objects which are construed as being highly affected."

the processing of transitive sentences. In the following, I will present some examples for the influence of argument animacy contrasts on sentence processing, both from comprehension and production studies. I will also illustrate how the central role of argument animacy information in sentence processing is reflected in their prominent role in two different models of sentence comprehension (Bornkessel-Schlesewsky and Schlesewsky, 2006; Kuperberg, 2007).

Trueswell et al. (1994) used eyetracking measurements to investigate the comprehension of written English object relative clauses. This construction allows the unusual appearance of the object *before* the verb in English. The verbs in their critical sentences were identical in the simple past and the past participle. They compared either reduced or unreduced relative clauses with animate or inanimate objects. Sentences in the inanimate object condition were not ambiguous in the reduced and the unreduced versions (*The evidence (that was) examined by the lawyer turned out to be unreliable*) because the inanimate object NPs did not fit the selectional restrictions for subjects of the relative clause verbs. These sentences did not show any indications of comprehension difficulty when compared between the reduced and unreduced verb forms, and neither when compared to sentences with unambiguous verbs (*The poster (that was) drawn by the illustrator was used for a magazine cover*). Sentences in the animate condition, however, were ambiguous in their reduced version until the disambiguating "by the ... " phrase (*The defendant (that was) examined by the lawyer turned out to be unreliable*). For reduced relative clauses, Trueswell et al. found longer first pass reading times on the disambiguating region (*by the lawyer*) and longer second pass reading times on the three first positions (*The defendant – examined – by the lawyer*) for the animate compared to the inanimate condition. The authors interpreted this as an indication that the reduced relative sentences in the animate condition cause higher processing costs than in the inanimate condition, because the first animate NP is routinely interpreted as the subject of the verb. The influence of animacy on the reading time measures was already visible during the first pass reading times on the disambiguating region. The sentences in the inanimate condition are not ambiguous because the inanimate NPs do not fit the verbs' selectional restrictions concerning subject animacy. This difference

between the animate and inanimate conditions was interpreted as a reflection of early interactions between syntactic and semantic processing. The results of this study are in contrast to earlier findings using comparable sentence material (Ferreira and Clifton, 1986), that showed part-of-speech information seemed to be processed earlier than semantic information (like the animacy of an NP). The findings by Trueswell at al. were taken to support parallel models of sentence comprehension (as opposed to strictly modular models of sentence comprehension, which only allow interactions during later processing steps; Trueswell et al., 1994, p.308).

Weckerly and Kutas (1999) investigated the comprehension of transitive written English sentences using ERP measurements. They investigated the processing of object relative sentences, comparing conditions with either inanimate objects (I(A): *The novelist that the movie inspired praised the director ...*) or animate objects (A(I): *The movie that the novelist praised inspired the director...*). The sentences were constructed so that neither animate nor inanimate objects violated the selectional restrictions of the verbs they were combined with. The results of this study showed that the ERP to the first NP was more negative-going for inanimate NPs (I(A): *movie*) than for animate NPs (A(I): *novelist*). This pattern switched on the fifth NP of the sentence (more negative ERP for A(I): *movie* than I(A): *novelist*). The ERPs to the verbs of the relative clauses were more positive-going for A(I) sentences (*praised*) than for I(A) sentences (*inspired*). The difference between the two conditions continued to influence the ERPs to most of the remaining words of the sentences. The authors conclude that the animacy of an NP's referent already influences early processing steps, and that its influence on the processing of object relative sentences lasts for a long time. They suggest that animacy influences different subprocesses during sentence comprehension. Their findings support accounts of sentence comprehension that allow early interactions between different types of information.

Frisch and Schlesewsky (2001) also report an ERP study on the effects of object animacy on sentence comprehension. They used German subordinate clauses with canonical NP-NP-Verb word order as their stimulus material. In the first condition, the first NP was animate, while the second was inanimate. The sentences were presented in one version with correct nominative-accusative

case marking, and in another version with ungrammatical nominative-nominative case marking (grammatical: *Paul fragt sich, welchen Förster der Zweig gestreift hat*, "Paul asks himself [which forester] ACC [the twig] NOM touched has". ungrammatical: *Paul fragt sich, welcher Förster der Zweig gestreift hat*, "Paul asks himself [which forester] NOM [the twig] NOM touched has"; glosses in original). In the second condition, both NPs were animate (grammatical: *Paul fragt sich, welchen Angler der Jäger gelobt hat*, "Paul asks himself [which angler] ACC [the hunter] NOM praised has"; ungrammatical: *Paul fragt sich, welcher Angler der Jäger gelobt hat*, "Paul asks himself [which angler] NOM [the hunter] NOM praised has"). The ERP to the ungrammatical animate-inanimate condition showed an enhanced P600 on the final verb when compared to the corresponding sentences with correct nominative-accusative German case marking. In the ungrammatical animate-animate condition, this enhanced P600 was also visible. In addition to this P600, the ERP to the final verb also showed an enhanced N400 component in the second condition when comparing the nominative-nominative to the nominative-accusative version of the sentences. The authors conclude that the P600 effect found in all ungrammatical sentences indicates additional processing costs caused by the violation of the German case marking pattern. They interpret the enhanced N400 in the ungrammatical animate-animate condition as a reflection of the additional processing cost caused by two animate arguments in the sentence. They conclude that the parser can use both case marking and animacy contrasts to assign thematic roles to the NPs in a sentence, and that a failure to use either is reflected in an enhanced N400.

fMRI measurements (Grewe et al., 2007) have also shown additional activation in the pars opercularis of the left inferior frontal gyrus for sentences violating linearisation principles based on animacy contrasts. The stimulus material in Grewe et al.'s experiment were grammatical passive sentences with three-place verbs, leaving the indirect and direct object of the active structures as overtly expressed arguments. Both arguments were morphologically marked for case on their articles. Word order was either subject-object or object-subject. The grammatical subject of the passive sentence was either animate (subject-object: *Dann wurde der Polizist dem Arzt vorgestellt*; object-subject: *Dann wurde dem Arzt der Polizist vorgestellt*; translation for both: "Then the.NOM policeman(.NOM)

was introduced to the.DAT doctor(.DAT)") or inanimate (subject-object: *Dann wurde der Mantel dem Arzt gestohlen*; object-subject: *Dann wurde dem Arzt der Mantel gestohlen*; translation for both: "Then the.NOM coat(.NOM) was stolen from the.DAT doctor(.DAT)"). The authors assumed that preferred word orders in a sentence are governed by a number of principles, the 'subject-before-object principle', the 'thematic hierarchy principle' (agents before recipients before patients) and the 'animacy principle' (animate arguments before inanimate arguments). The passivized ditransitive structures allowed them to monitor a conflict between the animacy principle with the other two principles. The authors found that the activation in the pars opercularis was higher for sentences with SO than with OS word orders if subjects were inanimate and objects were animate. If both arguments were animate, no activation difference was found between SO and OS word orders, suggesting that the activation difference was caused by the violation of the animate-before-inanimate principle.

Argument animacy influences not only the comprehension, but also the production of transitive sentences. McDonald et al. (1993) showed that animacy influences word order and grammatical role assignment in the production of English sentences. In a series of recall tasks, they found that animate arguments tend to be recalled early, and as grammatical subjects in transitive sentences. However, animacy did not influence the ordering of conjuncts, suggesting that animacy plays a more important role for word order when the animate and inanimate entities bear different grammatical roles.

Ferreira (1994) prompted the production of transitive English sentences by showing participants two NPs and a verb. The verb was either a verb with a 'normal' argument linking pattern (agent-theme or experiencer-theme, like *avoided*) or a theme-experiencer verb (like *challenged*). In a series of experiments, she showed that the thematic structure of the verb and the animacy of the argument NPs both influence whether an active or a passive sentence is produced. Ferreira concludes that speakers try to place more prominent thematic roles like the agent or experiencer into the subject position of the sentence.

Prat-Sala and Branigan (2000) suggest that animacy contributes to the *inherent* accessibility of a referent in sentence production, i.e., the part of its conceptual

accessibility[1] that is caused by an entity's intrinsic semantic properties, and is unalterable by the context. They contrast this property with *derived* accessibility, which is the part of an entity's conceptual accessibility that is caused by the linguistic or nonlinguistic context. The authors prompted sentence production in English and Spanish using a series of picture description task. To manipulate the saliency and hence the derived accessibility of the arguments, the picture was presented together with a short story providing context for the picture. If both arguments were inanimate, the more salient participant was realised as the grammatical subject (i.e., salient agents were realised as subjects of active sentences, salient patients as subjects of passive sentences). If one of the arguments was animate (and therefore had higher inherent accessibility), the arguments' animacy interacted with their saliency. In a context that made inanimate agents more salient, the typical preference for animate subjects was overriden, and the inanimate agents were realised as the grammatical subjects of active sentences. The authors conclude that inherent and derived accessibility combine and interact in sentence production to influence the overall accessibility of the arguments, and hence, word order and probably grammatical role assignment.

Van Nice and Dietrich (2003) prompted the production of German transitive sentences with a picture description task, showing the referents of two NPs performing an action. The pictures came in four different conditions, depicting situations where either the agent, or the patient, or both, or none, were animate. The results showed that speakers prefer animate arguments as the grammatical subjects of a sentence, and that they produce more passive sentences if the patient is animate than if it is inanimate.

In summary, psycholinguistic studies consistently show that the parser uses animacy contrasts in the processing of transitive sentences, with structures that have animates appearing before inanimates easiest to process. In comprehension,

[1]Bock and Warren (1985, p. 50): "Conceptual accessibility is the ease with which the mental representation of some potential referent can be activated in or retrieved from memory. We assume that conceptual accessibility is closely tied to characteristics of perceptual and conceptual representation, with accessible concepts being those that are in some sense most "thinkable"- those whose mental representations are learned earliest and are most richly detailed in adult representations of knowledge."

argument animacy contrasts are an important cue for assigning grammatical roles in the absence of formal cues like word order or case marking. If both kinds of cues are lacking, the processing cost is measurably increased.

The observation that argument animacy contrasts play an important role in sentence comprehension is reflected in different models of sentence comprehension. Kuperberg's model (Kuperberg, 2007) explains the use of different kinds of information in sentence comprehension with two parallel processing streams. One stream, called the semantic memory-based stream, calculates the lexical-semantic relationships between the words in the sentence, probably using information gained from accessing the mental lexicon entries of the individual words. The other stream, called combinatorial processing stream, in its turn consists of two parallel substreams. One of these substreams calculates morphosyntactic relationships, using information like word order, agreement and case marking. The other substream calculates lexical-thematic relationships, using animacy contrasts between the arguments. If a sentence has neither animacy contrasts nor morphosyntactic cues for distinguishing between the arguments, neither of the substreams of the combinatorial processing stream can parse the sentence, and representation building has to rely on the semantic memory-based stream. This leads to measurable increases in the processing cost of these sentences, compared to sentences with arguments that are distinguishable via at least one of the combinatorial processing streams.

The extended Argment Dependency Model (Bornkessel-Schlesewsky and Schlesewsky, 2006) also uses animacy and morphosyntactic information in building the representation of a transitive sentence. This model distinguishes between the processing of predicating and non-predicating elements in a sentence (which corresponds roughly to the difference between the verb and its arguments). According to this model, when an NP is encountered, its *prominence* is calculated based on a number of different factors. These include both morphosyntactic information and information like definiteness and animacy (reflecting the typological observations cited above). While animacy is assumed to influence sentence comprehension in all languages, the extent of its influence is assumed to depend on the specific language.

Both models reflect the observation that a sentence causes higher processing costs if subject and object are not clearly distinguishable via morphosyntactic information or animacy contrasts. Although animacy is one of several semantic properties of the participants in a transitive situation, animacy contrasts seem to play a special role in sentence processing that goes beyond general semantic processing.

1.2 Noncanonical verbs

1.2.1 Theoretical aspects of noncanonical verbs

The definition of prototypical transitivity outlined in the preceding section is based on the animacy of the participants in the transitive situation. Animacy is an inherent semantic property of the participants - they come into the situation already being animate or inanimate, and this property is not changed by the action denoted by most verbs.

The verb, however, assigns additional semantic properties to the participants - the ones they bear in the specific situation that the sentence describes. I will call these semantic properties the *derived* semantic properties of the participant, to better distinguish them from the inherent semantic properties like animacy. (In distinguishing between inherent and derived semantic properties, I loosely follow the diction in the sentence production literature, distinguishing between inherent and derived conceptual accessibility, see Prat-Sala and Branigan, 2000, described above. I do not suggest that semantic properties can be used interchangeably with conceptual accessibility. However, I believe that the characteristics of a referent that are unchangeable and those that are influenced by the linguistic context should influence processing both in sentence production and comprehension, and can provide promising starting points to investigate parallels and differences between both modalities.)

Prototypical transitivity can also be defined based on these derived semantic properties. Since the derived semantic properties depend on the action performed

in the transitive situation, this second definition of prototypical transitivity is based on the verb and the action it denotes.

In this section of the Introduction, I will present some verb-based accounts of prototypical transitivity. These accounts offer detailed descriptions of how a verb's semantics can deviate from prototypical transitivity, and how deviations from prototypical transitivity can be reflected in the syntactic behaviour of a verb. I will then take a closer look at one specific syntactic symptom of non-prototypical transitivity, namely, noncanonical case marking in German. After giving some background information on German noncanonical case marking verbs, I will conclude this section with an overview of previous psycholinguistic studies, showing that deviations from the verb-based definition of prototypical transitivity cause increases in processing cost, just like deviations from the animacy-based definition do. The final section of the Introduction will be dedicated to explain the hypothesis that was tested in this thesis, and will use both definitions of prototypical transitivity.

The first verb-based definition of prototypical transitivity presented here is formulated by Dowty (1991) in his account of argument linking. Its aim is to provide a link between the semantics of a situation and the syntax of the sentence describing it. In contrast to previous accounts of argument linking (e.g., Chomsky, 1981; Fillmore, 1986; Jackendoff, 1987, see Dowty, 1991, p.549 for details), Dowty rejects traditional thematic roles like *agent*, *patient*, *theme* or *experiencer* as part of an explanation for which argument is realised as the grammatical subject and which as the object[1]. He proposes that instead of discrete, semantically complex thematic roles, verbs assign a whole range of semantic properties to their arguments. Unlike discrete thematic roles (which unite a number of different semantic properties in a fixed combination), the semantic properties suggested by Dowty are assigned independently of each other. Their distribution to the participants depends on the situation described by the verb. Dowty defines the prototypically transitive situation as one where these independent semantic

[1] Dowty (1991, 571 f.) proposes that "we may have had a hard time pinning down the traditional role types because role types are simply not discrete categories at all, but rather are cluster concepts (...).".

properties are distributed among the participants in a specific way. This prototypically transitive distribution of semantic properties is illustrated in Table 1.1. The table contains the semantic properties formulated by Dowty, grouped into two sets called *role types*, namely Proto-Agent and Proto-Patient. In a prototypically transitive situation described by a prototypically transitive sentence, the semantic properties of the Proto-Agent are assigned to one argument, and the semantic properties of the Proto-Patient are assigned to the other. In a situation that is not prototypically transitive, arguments may have different "degrees of membership" (quotes in original) in these semantic proto-roles, meaning that a verb may assign all, some or none of the Proto-Agent properties to one argument. Thus, two arguments may bear any combination of these semantic properties.

The distribution of the semantic properties to the arguments explains the mechanisms of argument linking, according to the Argument Selection Principle (Dowty, 1991, p.576). This Principle states that the grammatical subject of a verb will be the argument bearing the greatest number of Proto-Agent properties, while the direct object will be the argument with the greatest number of Proto-Patient properties. For three-place verbs, this Principle states that the non-subject argument with the greatest number of Proto-Patient properties will be the direct object, while the other non-subject argument will be an oblique or prepositional object. Dowty's examples of prototypically transitive verbs include the verbs *build* (a house), *write* (a letter), *murder*, *eat*, *was* (a plate).

A deviation from the semantics of the prototypically transitive situation can be reflected in the syntax of the verb. Dowty formulates this in Corollary 1 of the Argument Selection Principle, stating that "If two arguments of a relation have (approximately) equal numbers of entailed Proto-Agent and Proto-Patient properties, then either or both may be lexicalized as the subject (and similarly for objects)." A participant traditionally described as an experiencer, for example, would be described as bearing the property of sentience, but not of volition or causation (Dowty, 1991, p. 577). Therefore, it has a lower degree of membership in the Agent proto-role than a prototypical agent, a fact that will influence its grammatical role together with the semantic properties of the other participant. The Argument Selection Principle thus explains the existence of verb pairs like *like* vs. *please* or *fear* vs. *frighten*. These verbs describe very similar actions,

Agent Proto-Role	Patient Proto-Role
volitional involvement in the event or state	undergoes change of state
sentience (and/or perception)	incremental theme
causing an event or change of state in another participant	causally affected by another participant
movement (relative to the position of another participant)	stationary relative to movement of another participant
(exists independently of the event named by the verb)	(does not exist independently of the event, or not at all)

Table 1.1: Semantic properties contributing to the Agent and Patient proto-roles, according to Dowty (1991)

but realise their arguments in different syntactic roles (Dowty, 1991, p.579). A situation where Peter is afraid of a spoon can be described with two different sentences using two different verbs, resulting in the sentences *Peter fears the spoon* and *The spoon frightens Peter*. Both participants in the situation bear semantic properties associated with the Agent proto-role - Peter is sentient and perceives the event, and the spoon causes the event and Peter's change of state (see Table 1.1). Therefore, both can be realized as the grammatical subject of an active sentence, depending on the verb chosen.

It is worth while to compare this verb-based definition of prototypical transitivity to the animacy-based one outlined above: Both sentences about Peter and the spoon are not prototypically transitive, according to Dowty's definition. Still, Peter is animate, while the spoon is not animate. Therefore, the sentence *Peter fears the spoon* does not deviate from the definition of prototypical transitivity based on argument animacy. In Dowty's account, animacy is not among the semantic properties of the Proto-Agent. It is strongly implied in the Proto-Agent properties of 'sentience / perception' and 'volitional involvement'. However, the Proto-Patient property 'affectedness' can also be argued to be linked to animacy (see Næss 2004 for a discussion of the interplay between individuation, animacy and affectedness, in her review of Differential Object Marking).

As this first verb-based definition of prototypical transitivity has shown, a verb having an inverse argument linking pattern is a symptom of non-prototypically

transitive semantics. In case-marking languages like German, a verb's non-prototypically transitive semantics can also be reflected in a noncanonical case marking pattern.

German has four cases (nominative, genitive, dative and accusative) that are morphologically marked on determiners, nouns and adjectives preceding nouns. Because of widespread case syncretism (cf. Bayer et al. 2001; Krifka 2009), case is not always visible in a word's morphology. Case marking is used to mark grammatical roles in German (unlike English, where this function is fulfilled mainly by word order). German two-place verbs with a canonical case marking pattern assign nominative to their subjects and accusative to their objects. For ditransitive verbs (like *geben*, "to give"), the case marking pattern is nominative for subjects, dative for indirect objects and accusative for direct objects.

Not all German two-place verbs follow this canonical case marking pattern, though. A small number of two-place verbs assign nominative and dative case to their arguments, and an even smaller number assign nominative-genitive. In this dissertation, I will ignore the rare nominative-genitive assigning verbs, and the verbs that assign prepositional objects (e.g. *an etwas glauben*, "to believe in something"), and will only consider the nominative-dative assigning verbs when referring to 'noncanonical case marking'[1]. According to Meinunger (2007, p.13), these nominative-dative assigning verbs make up at most ten percent of all German verbs, and likely less than that.

The behaviour of German noncanonical case marking verbs differs from canonical nominative-accusative marking verbs. One example is the retainment of the noncanonical case under passivisation: For a canonical case marking verb, the accusative object of an active sentence is realised as the nominative subject of a passive sentence (*Der Junge wird unterstützt* "The.NOM boy(.NOM) is supported"). The object of a noncanonical case marking verb, however, retains the dative case even as the subject of a passive sentence (*Dem Jungen wird geholfen* "The.DAT boy(.DAT) is helped".) German dative-assigning verbs can have different un-

[1]The noncanonical case assigned by these verbs is sometimes also called lexical case, inherent case, nonstructural case or idiosyncratic case. I will call the nominative-dative assigning verbs 'noncanonical' verbs, and will only use the other terms when discussing the literature that proposes them in the Introduction. The datives that I will concentrate on in this study are not the free datives (as, for example, described in detail in Hole 2008).

marked word orders (e.g., Haider, 2010, 267[1]). One group of the noncanonical case marking verbs have an unmarked DAT-NOM word order, following the pattern of experiencer verbs like *gefallen* in *Dem Jungen gefällt der Film*, "The.DAT boy(.DAT) [is.pleased.by] the.NOM movie(NOM)"[2]. The unmarked argument order in the German sentence is opposite that of accusative-assigning NOM-ACC verbs in sentences like *Der Junge mag den Film*, "The.NOM boy(.NOM) likes the.ACC movie(.ACC)".

Another group of German dative-assigning verbs show an unmarked NOM-DAT word order. These verbs, like *folgen* (*Der Junge folgt dem Auto*, "The.NOM boy(.NOM) follows the.DAT car(.DAT)", are usually called *active dative verbs* in the psycholinguistic literature, to distinguish them from verbs like *gefallen* that realise the experiencer-like participant as an sentence-initial object in the unmarked word order. (In some syntactic analyses, the active dative verbs are divided into further subgroups, assigning either high or low dative. I will briefly return to these analyses later in this section.)

Using and extending Dowty's definition of prototypical transitivity, Blume (2000) shows that crosslinguistically, verbs with noncanonical case marking pattern always denote events with non-prototypically transitive semantics. Just like English object-experiencer verbs, the German noncanonical case marking verbs do not assign the semantic properties belonging to the Agent and Patient proto-roles in the prototypically transitive distribution. Neither of the arguments is a perfect Proto-Agent or Proto-Patient, and the situation is *less transitive* than prototypical (Blume, 2000, chapt. 6). The noncanonical case marking verbs therefore differ both in their syntax and semantics from prototypically transitive accusative-assigning verbs. In this dissertation, I follow Blume in assuming that a German verb assigning nominative-dative to its argument is guaranteed to denote an event that is not prototypically transitive[3].

[1]Haider (2010, 267) " (...) in German the order of arguments is determined by the lexical argument structure (whose structure is in part a function of the lexical-conceptual structure). So there are different base orders for different verb classes. There are verbs with NOM-DAT base order contrasting with verbs with DAT-NOM base order, and there are verbs with DAT-ACC base order contrasting with verbs with ACC-DAT base order."

[2]*gefallen* translates as active "to please", but the unmarked word order is dative experiencer - nominative stimulus.

[3]Blume (2000, p.176): "Ein syntaktisch eingeschränkt transitives Verb ist niemals seman-

Agent Proto-Role	Patient Proto-Role
volition	no volition
sentience	no sentience
instigation	no instigation
motion	no motion
existential persistence (beginning)	no existential persistence (beginning)
existencial persistence (end)	no existencial persistence (end)
qualitative persistence (beginning)	no qualitative persistence (beginning)
qualitative persistence (end)	no qualitative persistence (end)

Table 1.2: Semantic properties contributing to the Agent and Patient proto-roles, according to Grimm (2010)

The link between non-prototypically transitive semantics and noncanonical case marking is further developed by Grimm (2010). In his account, case marking and argument linking directly reflect the combination of semantic properties that a verb assigns to its arguments. Table 1.2 lists the semantic properties defined by Grimm, grouped into properties contributing to the Agent proto-role or the Patient proto-role. Importantly, Grimm only defines the semantic properties of the Agent proto-role, while the semantic properties of the Patient proto-role are defined as the negative of their corresponding Proto-Agent properties. Any number of these semantic properties can be arranged in different combinations, each of which has a specific place in a two-dimensional structure that Grimm calls the *agentivity lattice*. Depending on the event denoted by the verb, the required semantic properties of the arguments can then be mapped onto this structure. A predicate is high in transitivity if its arguments are mapped to distant locations on the lattice, and low in transitivity if the arguments are closer.

Certain regions on the agentivity lattice are associated with certain traditional thematic roles like agent and patient, and, for case marking languages, with specific cases. One region holds the combinations of semantic properties assigned to indirect objects (this would correspond to the traditional thematic role of 'recipent', among others), and is associated with the syntactic function of indirect object and dative case. The semantic properties of the objects of German NOM-DAT verbs map onto this region, and therefore the objects bear dative case which is usually reserved for indirect objects (Grimm, 2010, chapt.5). In Grimm's account,

tisch stark transitiv.", "A verb that with limited syntactic transitivity never has strong semantic transitivity." (my translation)

the noncanonical case marking pattern therefore is in fact semantically regular[1].

Meinunger (2007) arrives at a similar conclusion, using traditional discrete thematic roles instead of combinations of independent semantic properties. His account of German dative-assigning verbs includes a reevaluation of Blume's work, a more complete list of German noncanonical dative-assigning verbs and three different classifications of these verbs. In his semantic-thematic classification, Meinunger reviews the thematic roles associated with dative arguments, and separates the noncanonical dative-assigning verbs into groups according to the thematic properties of their arguments. Taking as an example the class of noncanonical case marking verbs called *interaction verbs* like *folgen, helfen, zusehen, zuhören* ("to follow, to help, to watch, to listen", see also Blume, 2000), Meinunger (2007, 14) states that the objects of these dative-marking verbs are more agentive than objects of nearly synonymous accusative-assigning verbs (like *unterstützen, sehen, hören*, "to support, to see, to hear"; all nominative-accusative). Meinunger stresses the subtle semantic differences between accusative and dative assigning verbs, using the example verb pair *helfen* and *unterstützen*. He claims that the object of *helfen* has to be doing something itself in the first place to be helped, while *unterstützen* also works with more abstract objects like ideas, things or demands[2]. In line with Næss (2004), Meinunger distinguishes between agentivity and animacy, assuming that the relationship between dative case marking and animacy is only indirect, and that 'relatively agentive' objects do not necessarily have to be animate or human to allow dative case marking[3]. Contradicting accounts that describe dative in nominative-dative marking verbs as lexical, idiosyncratic or non-structural case (e.g., Haider, 1993, see below), Meinunger argues that dative

[1] "Uses of case such as the dative marking experiencer subjects have often been seen as idiosyncratic, but the above demonstrates that these types of case assignment fall out naturally from the semantic properties associated with a case marker and the semantic properties demanded by such psychological predicates." (Grimm, 2010)

[2] Meinunger (2007, 14): "Das Objekt von ‚helfen' muss immer auch selbst etwas tun, wobei ihm dann geholfen werden kann. Es muss also selbst handelnd sein. ‚Unterstützen' ist weniger restriktiv: man kann eine Forderung, eine Sache, eine Idee usw. unterstützen. ‚Helfen' geht mit solchen Objekten nicht."

[3] Meinunger (2007, p. 14):"Dativobjekte bezeichnen demnach in dieser Klasse relativ gesehen agentivere Aktanten als akkusativisch markierte (...). ‚Relativ agentiv' muss allerdings nicht bedeuten, dass das fragliche Objekt in jedem Fall für die Merkmale [+belebt] oder [+human] spezifiziert sein muss. Es lassen sich durchaus Beispiele finden, wo das Objekt eine unbelebte Instanz bezeichnet."

in these patterns can largely be predicted by the semantics of the nominative-dative assigning verbs (Meinunger, 2007, p. 17 f.). He proposes that case serves to mark the (traditional) thematic roles of the arguments in a sentence in a regular fashion. According to this view, a two-place verb assigns the most marked case to the thematically most marked argument, while the remaining argument gets the thematically neutral nominative (S.21). Dative (rather than accusative) is assigned if one of the two arguments is affected by the action denoted by the verb. Importantly, Meinunger assumes that the semantic-thematic distinction between accusative and dative assigning verbs holds for all kinds of dative verbs. Therefore, the morphosyntactic differences between the verbs with incorporated separable prepositions (e.g., *nachlaufen*, "run after", *zuhören*, "listen to") and morphologically simple verbs (e.g., *helfen*, "to help") do not affect their thematic-semantic properties. All dative-assigning verbs show certain thematic-semantic regularities, irrespective of whether the dative case is assigned by the verb or by an incorporated preposition.

Not all analyses of noncanonical case marking verbs agree that noncanonical case is predictable from the verbal semantics. Haider (1993, 120) compares noncanonical case marking verbs to prepositions, argueing that their case assignment patterns cannot be reliably deduced from their semantics, and therefore have to be learnt. He illustrates his point with the usual example of *helfen* ("to help") which assigns dative, while *unterstützen* ("to support") assigns accusative to its object. Haider claims that there is no transparent rule explaining the different case marking patterns, and that therefore, the fact that a verb assigns noncanonical case or a prepositional object is an idiosyncratic fact that needs to be stored in the lexicon[1]. In Haider (2010), he restates this point, again explaining why a verb's syntactic behaviour is not predictable from a verb's semantics[2]. Czepluch's view

[1]Haider (1993, p.120): "Weder der inhärente Kasus eines Komplements noch das Auftreten eines Arguments als Präpositionalobjekt ist vorhersagbar. Die konkrete Ausstattung eines lexikalischen Elements mit inhärenten Lizenzeigenschaften aus dem zur Verfügung stehenden Fundus ist eine Eigenschaft, die gelernt wird. Sie ist nicht deduzierbar. Es scheint keine transparente Regel zu geben, die bewirkt, dass *helfen* ein Dativ-Objekt regiert, *unterstützen* aber ein Akkusativ-Objekt, dass *überdrüssig* einen Genitiv, *abgeneigt* aber einen Dativ verlangt. Das Erfordernis eines Präpositionalobjekts sowie die Form der Präposition wird durch da Verb determiniert und gilt ebenfalls als idiosynkratische Eigenschaft."

[2]Haider (2010, 252): "In German there are three morphologically different ways of specifying the licensing relation for an object in the argument structure. First, the argument may be

of noncanonical case marking verbs (Czepluch, 1996) is comparable to Haiders (Haider, 1993), assuming that datives (and genitives) on single objects represent lexical case (Czepluch, 1996, p. 137f.). However, Czepluch contradicts Haider (1993) with respect to the dative indirect objects, stating that these are not lexical.

The accounts presented here tend to explain noncanonical syntactic behaviour - like noncanonical case marking - as a reliable indicator of nonprototypically transitive semantics. The verbs that mark nominative-dative in German denote events that are 'less transitive' or 'lower in transitivity' than prototypically transitive nominative-accusative assigning verbs. While the semantic properties of the arguments in Dowty's and Grimm's accounts do not include animacy, some of them like sentience and volition strongly imply animacy, providing an indirect link between animacy and case marking patterns.

Opinions differ on whether noncanonical case marking only indicates nonprototypically transitive semantics, or whether this regularity also holds in the opposite direction - i.e., whether all non-prototypically transitive events are denoted by verbs that assign noncanonical case marking pattern. This in turn would suggest that no verb assigning the canonical nominative-accusative pattern could denote a non-prototypically transitive event. Blume (2000, p.1) explains in the Introduction that a verb's noncanonical case marking pattern is not *determined* by its meaning. However, she stresses that this does not imply that the semantic properties of the verb do not *license* noncanonical case marking[1]. Other accounts

unspecified for a specific case in the lexical argument structure. This is what we refer to as a structural case relation. Second, it may be specified for a specific case. This is he lexical case, and it is invariant. Third, the argument may be lexically determined as a category with a specific case licenser .This is what we are used to calling a prepositional object. The preposition is determined by the selecting verb. The preposition is semantically vacuous, but it is a case licenser. Prepositional objects are truly idiosyncratic with respect to the choice of the preposition. This is easy to verify cross-linguistically. More often than not, the preposition in a given language does not match its translational counterpart in the other language."

[1] "Die Auffassung der idiosynkratischen Valenzwahl dieser Verben wird häufig durch den Hinweis auf bedeutungsverwandte Verben mit unmarkierter Valenz, z.B. *unterstützen* als Pendant zu *helfen*, motiviert. Damit ist jedoch nur gezeigt, daß Verben mit verwandten Bedeutungen sowohl markierte als auch unmarkierte Valenzen wählen können, daß die Wahl der markierten Valenz also nicht durch die Verbbedeutung determiniert wird. Es ist damit jedoch nicht bewiesen, daß die Wahl der markierten Valenz nicht durch bestimmte semantische Eigenschaften der betreffenden Verben lizenziert wird." (Blume, 2000, p.1)

put more emphasis on the semantic regularity of the noncanonical case marking verbs (e.g., Meinunger 2007, footnote12, p.21f.).

In this dissertation, I will assume that noncanonical case marking always indicates a deviation from semantic prototypical transitivity, and I will also assume that the semantics of these verbs deviate from prototypical transitivity in a regular way. I will further assume that the regularity only holds in the direction from syntax to semantics. This means that I will assume that all NOM-DAT assigning verbs denote non-prototypically transitive events, but that not all non-prototypically transitive events are denoted by NOM-DAT verbs (i.e., a non-prototypically transitive event can also be denoted by a NOM-ACC verb). Under this assumption, the fact that a verb assigns noncanonical NOM-DAT needs to be part of the lexical information of this verb, and allows certain predictions about the semantics of the event denoted by the verb.

As outlined above, the noncanonical case marking of dative-assigning two-place verbs is a reliable symptom of non-prototypically transitive semantics. Obviously, these verbs also differ syntactically from nominative-accusative assigning verbs.

There is a general consensus that German datives are assigned in a different position than accusative, and that there is not one single syntactic position where dative is assigned. This is true even for the dative objects of regular ditransitive/ three-place verbs, some of which, like (*kaufen* "buy", *schenken* "give (as a gift)", or *verweigern* "deny") show underlying NOM-DAT-ACC word order. Others (*aussetzen* "expose", *unterziehen* "subject to", *vorausschicken* "send ahead of") show underlying NOM-ACC-DAT word order (see, e.g., Haider 2010, 267, Meinunger, 2000, 44ff., Fanselow, 2000, McFadden, 2004, 104ff, verb examples from McFadden, 2004). But also the two-place verbs assigning noncanonical nominative and dative come with different unmarked word orders, either NOM-DAT or DAT-NOM - and some accounts even divide the NOM-DAT verbs into further subgroups, assigning their datives in different syntactic positions.

Bayer et al. (2001, p. 480) suggest that oblique cases like dative and genitive are assigned in a special projection KP (for *Kase Phrase*), that is specified for oblique case morphology. (In this account, nominative and accusative are struc-

tural cases, while dative and genitive are always oblique cases.) The authors assume that, in sentence processing, the parser has to reaccess the lexical entry of the dative argument if the dative morphology is not overtly expressed, and that this additional work of lexical reaccess is not necessary in the assignment of accusative case.

In his OT-inspired analysis of exceptional case marking patterns (like noncanonical nominative-dative), Fanselow (2000) proposes that an exceptional case must be part of the lexical entry of the verb (Fanselow, 2000, S.177) and must be assigned by the lexical verb[1], and is always assigned in the lowest available position in a sentence. A similar view is taken by Czepluch (1988)[2].

Woolford (2006) distinguishes two different kinds of non-structural cases, namely, *inherent* and *lexical* cases. According to her proposal, German datives can be inherent datives, which are reserved for indirect objects and are licensed by little/light v heads. But datives can also be lexical datives, which are assigned by lexical heads like V or P, and which are never assigned to external arguments. Therefore, the datives of noncanonical case marking verbs with NOM-DAT arguments must be assigned by V. Woolford assumes that inherent datives are regular, whereas the lexical datives are "truly idiosyncratic" (Woolford, 2006, p. 112f.).

McFadden (2004, 127ff) suggests that the syntactic positions where dative is assigned are the same for German noncanonical case marking verbs and ditransitive verbs. In his account, two-place verbs assigning noncanonical dative can be grouped into different classes. The *helfen* class verbs (including *helfen* "to help", *glauben* "to believe", *gehorchen* "to obey") assign dative in the position of indirect objects of ditransitive verbs (in McFaddens account, this is the specifier of a projection called $v_{APPL}P$). The *gefallen* class (including *gefallen*, "to please", *gehören*, "to belong) work like ditransitive verbs with dative-accusative word order, but do not have an external subject. Like the *helfen*-verbs, they assign dative in $v_{APPL}P$, while assigning the nominative in a lower position. The unmarked word order in these verbs is DAT-NOM. In contrast to these two kinds of high datives, the low

[1] "Exceptional cases must be specified in the lexical entry of the full verb, (...)i.e., they must be assigned by the lexical verb." (Fanselow, 2000, p. 185)

[2] "structurally Case-marked Objects are realized to the left of the DO argument, and inherently Case-marked Objects are realized to the left of the DO argument, and inherently Case-marked Objects are realized to the right of the DO argument." (Czepluch, 1988, p. 101)

dative-assigning verbs work like ditransitives without a direct object, but with an external argument in Spec-vP. The dative is assigned to the objects in a PP that is a sister to V. This class includes *ausweichen* "to avoid", *entegegenkommen* "to come toward", and many other verbs with incorporated separable prepositions. It also includes verbs like *folgen* "to follow", which do not have separable prepositions. (See also Meinunger, 2006 for a similar account of high and low dative positions.)

In this dissertation, I will assume that the group of German noncanonical case marking verbs is in all likelihood syntactically heterogenous. Following the current practice in the psycholinguistic literature, I will distinguish between verbs with unmarked NOM-DAT and DAT-NOM word orders, and will allow for the possibility that the former group (usually referred to as 'active dative verbs') includes further subgroups. Bearing these differences between noncanonical case marking verbs in mind, I will assume that noncanonical dative case should always be assigned in a different position than accusative case for single objects, and that therefore, upon encountering a dative-assigning verb, the parser will have to rebuild the syntactic structure of the sentence. Following Czepluch (1988), Fanselow (2000) and Haider (2010), I will further assume that noncanonical case marking is part of the lexical entry of a verb. If this kind of lexical information should be psychologically real, it should contribute to an increase in processing cost of noncanonical compared to canonical verbs.

1.2.2 Processing noncanonical verbs

As outlined above, deviations from prototypical transitivity (defined via the semantic properties assigned to the arguments by the verb) are crosslinguistically reflected in noncanonical argument linking and case marking patterns. Not surprisingly, these deviations from prototypical transitivity also affect sentence processing and lead to increases in processing cost, when compared to the processing of canonical transitive sentences. In the following, I will present some examples for the influence of noncanonical argument linking patterns or noncanonical case

marking patterns on sentence comprehension.

In English, non-prototypical transitivity is mainly reflected in non-standard argument linking patterns. Verbs with unusal argument-linking patterns like object-experiencer verbs have been shown to cause higher processing costs than standard transitive verbs. Cupples (2002) investigated the comprehension of active and passive sentences with theme-experiencer verbs (like *to amuse*), experiencer-theme verbs (like *to cherish*) and action verbs (like *to clean*) in a series of experiments. In their first experiment, they measured plausibility ratings and the time to perform the ratings of implausible sentences and plausible filler sentences with all three kinds of verbs. (Implausible sentences with theme-experiencer verbs: *The messenger convinced the diagram / The diagram was convinced by the messenger*; experiencer-theme verbs: *The tunnel liked the youngster / The youngster was liked by the tunnel* and action verbs: *The signature refused the supplier / The supplier was refused by the signature*). Cupples found that active sentences with theme-experiencer verbs had longer rating times than active sentences containing the other verbs. Passive sentences with theme-experiencer verbs had higher accuracy in the plausibility ratings than passive sentences containing other verb classes. She did not find differences between action verbs and experiencer-theme verbs. In a second experiment, Cupples investigated the comprehension of active and passive sentences containing theme-experiencer and experiencer-theme verbs with self-paced reading times. (theme-experiencer verbs: *The remark encouraged the dancer / The dancer was encouraged by the remark*; experiencer-theme verbs: *The suspect imagined the threat / The threat was imagined by the suspect*; implausible fillers: *The doctor harassed the stethoscope / The landlord was noticed by the leak / The chair expected*). The results of the self-paced reading task showed that active sentences with theme-experiencer verbs caused greater processing difficulty than those with experiencer-theme verbs, leading to longer reading times on the postverbal word. Cupples concludes that theme-experiencer verbs differ syntactically from action and experiencer-theme verbs, and that this difference influences processing. Bader et al. (2000) investigated the comprehension of German transitive sentences with verbs marking canonical NOM-ACC or noncanonical NOM-DAT case (active dative verbs). In two experiments, they elicited grammaticality judgments of transitive sentences that were locally am-

biguous with respect to case marking. The critical sentences had object-subject word order (*Wessen Anwalt.*(DAT)/(ACC) *denkst du, half/informierte der.*NOM *Lehrer.*(NOM), "Whose lawyer do you think did the teacher help/inform?"), while control sentences had subject-object word order (*Wessen Anwalt.*(NOM) *denkst du, half dem.*DAT *Lehrer.(*DAT*) / informierte den.*ACC *Lehrer.(*ACC*)*, "Whose lawyer do you think helped the.DAT teacher / informed the.ACC teacher?"). Their results indicate that word order did not affect grammaticality judgments and reaction times for accusative assigning verbs. In the dative-assigning condition, they found longer reaction times and a lower percentage of correct judgments for object-subject word order compared to subject-object word order. They interpret their findings as indicating stronger garden paths in the dative assigining condition, caused by the restructuring of the syntactic representation of the sentence, and by lexical reaccess to check for dative morphology on the object NPs.

The processing of dative instead of accusative verbs also has been shown to affect ERP signals. Hopf et al. (1998) investigated the comprehension of German verb-final relative sentences with dative- or accusative-assigning verbs. They compared between two conditions that were ambiguous for accusative or dative case marking until the final verb (*Dirigenten.*DAT/ACC*), die ein schwieriges Werk einstudiert haben, kann ein Kritiker ruhig applaudieren(dative-assigning) / umjubeln(accusative-assigning)*; "Conductors.DAT/ACC who have rehearsed a difficult opus a critic can safely applaud / cheer") and a third condition that was unambiguously marked for dative case on the first NP (*Musikern.*DAT*, die ein schwieriges Werk einstudiert haben, kann ein Kritiker ruhig applaudieren(dative-assigning)*; "Musicians.DAT who have rehearsed a difficult opus a critic can safely applaud"). They found that the ambiguous dative sentences showed a broad negative shift in the ERP signal about 300 ms after the presentation of the critical verb, compared to accusative ambiguous and dative unambiguous conditions. Hopf et al. attributed this negative shift to the restructuring of the syntactic representation of the sentence that became necessary when the dative-assigning verb had been encountered. Unlike true syntactic reanalysis (that would have been expected to result in a P600 component rather than a negativity), they conclude that the syntactic representation can be successfully rearranged by assigning dative case. The authors argue that this process needs lexical reaccess to check for

dative morphology on the object NP. They interpret their findings as an N400 reflecting lexical reaccess.

While dative-assigning verbs are processed differently from accusative-assigning verbs, dative-assigning verbs can be further distinguished between the ones assigning NOM-DAT and DAT-NOM word orders. Dative-assigning verbs with different unmarked word orders have different influences on sentence processing. Bornkessel et al. (2004) investigated the effects of word order variation on transitive sentences with accusative- and dative assigning verbs. The found that in the accusative condition, object initial sentences produced a P600 (SO: *dass Maria Sängerinnen besucht, ...*, "that Maria singers.PL visits.3.SG, .."; OS: *dass Maria Sängerinnen besuchen*, "that Maria singers.PL visit.3.PL."). In the dative condition, (SO: *dass Maria Sängerinnen folgt, ...*, "that Maria singers.PL follows.3.SG, .."; OS: *dass Maria Sängerinnen folgen*, "that Maria singers.PL follow.3.PL."), they found an N400 component to object initial orders instead. In a second experiment, they investigated the influence of word order on the processing of dative assigning verbs in more detail, comparing active NOM-DAT and initial-object experiencer DAT-NOM verbs (SO: *dass Maria Sängerinnen gefällt, ...*, "that Maria singers.PL pleases.3.SG"; OS: *dass Maria Sängerinnen gefallen,...*, "that Maria singers.PL please.PL,..."). They found that the distribution of the negativities associated with object initial word orders depends on whether the dative assigning verbs have unmarked word orders DAT-NOM or NOM-DAT (active dative verbs). The authors suggest that while the reanalysis of case marking and of phrase structure both cause higher processing costs, dative object experiencer verbs may activate a dative-nominative word order pattern. This could reduce the processing cost for object-subject word orders with these verbs, compared to object-subject word orders for accusative or active dative assigning verbs. They conclude that the revision of case marking is reflected in an N400 component, whereas the revision of phrase structure is marked by a P600.

In summary, the literature indicates that dative-assigning verbs cause higher processing costs than accusative-assigning verbs in the comprehension of transitive sentences. Although case marking is a morphosyntactic phenomenon, revisions of case marking are reflected in N400 rather than P600 components traditionally associated with syntactic revisions. The difference between the process-

ing of accusative- and dative-assigning verbs are explained as reflecting additional processing cost caused by a restructuring of the syntactic representation and by lexical reaccess to check the object NPs for dative morphology (Bader et al., 2000; Hopf et al., 1998) or by a principled difference between revisions of phrase structure and case marking (Bornkessel et al., 2004). Furthermore, there is evidence that 'active' dative verbs with unmarked NOM-DAT word order are processed differently from verbs with unmarked DAT-NOM word order. The explanations cited here are based on the syntactic and lexical properties of dative-assigning verbs, but not on their non-prototypically transitive semantics.

Deviations from the verb-based definition of prototypical transitivity are reflected in sentence processing, just like deviations from the animacy-based definition. In the following section, I will conclude the Introduction to my dissertation by elaborating why both deviations should interact in sentence comprehension. I will then propose the hypothesis that was tested in the experiments, presented in the remainder of the thesis.

1.3 Noncanonical arguments meet noncanonical verbs

In the preceding sections, I have presented two definitions of prototypical transitivity. The first is motivated by typological and corpus linguistic research and is centered around animacy contrasts between the participants in the transitive situation, i.e. an inherent semantic property of the participants. Animacy contrasts between the arguments of a sentence are known to be an important cue in sentence parsing for distinguishing between subjects and objects. Deviations from this type of prototypical transitivity have been shown to cause higher processing costs in sentence comprehension.

The second definition of prototypical transitivity is based on the transitive verb of the sentence and the semantic properties it entails to the participants in the transitive situation, i.e., their derived semantic properties. A verb denoting a specific kind of situation with a specific distribution of semantic properties is defined as prototypically transitive. Deviations from this type of prototypical

transitivity can be reflected in the syntax of the verbs denoting these situations. One of the syntactic symptoms of non-prototypically transitive semantics is noncanonical case marking.

In general, noncanonical case marking verbs have less agentive subjects and more agentive objects (Grimm 2010; Meinunger 2007, Primus 1999) than canonical case marking verbs. Deviations from this verb-based kind of prototypical transitivity have been shown to cause higher processing costs in sentence comprehension.

Both aspects of prototypical transitivity (the one based on contrasts in argument animacy, and the one based on contrasts in argument agentivity) affect sentence comprehension. Why should the processes using both kinds of transitivity interact?

Agentivity is not identical to animacy. Still, animate beings undoubtedly make rather good agents. In the psycholinguistic literature, it is well-known that building a representation of a situation with two animate NPs is difficult for the parser, unless morphosyntactic information helps to assign grammatical and thematic roles. How does the parser react to this deviation from prototypical transitivity when confronted with a second deviation, namely, a dative-assigning verb signaling that the object is not only animate, but also more agentive than expected? If both aspects of prototypical transitivity are not linked in sentence comprehension, this could simply lead to even higher processing costs than for one deviation alone. But if both aspects are linked, the dative-assigning verb should facilitate the processing of a more agentive object (even though the dative-assigning verb itself probably causes higher processing costs in its own right). This facilitation should lead to *less difficulty* for sentences with two animate arguments if the verb assigns dative than if it assigns accusative case.

Based on findings from the literature reviewed above, I assume that the parser uses both animacy contrasts and case marking patterns during representation building in sentence comprehension. I further assume that noncanonical case marking patterns always indicate non-prototypically transitive semantics.

Therefore, I propose the following hypothesis:

During the comprehension of transitive sentences, the processes that use argument animacy information interact with the processes that use verb class information. In sentences with prototypically transitive NOM-ACC assigning verbs, animate objects will cause higher processing costs than inanimate objects in the absence of morphosyntactic information. In sentences with NOM-DAT verbs, however, this effect of object animacy will be modulated by the verb class. This could be reflected in less processing difficulty associated with animate objects of dative-assigning verbs, or in different time courses for object animacy effects in sentences with dative-assigning verbs.

For this dissertation, I performed four different experiments to test this hypothesis. I will describe the language material used in these experiments in the next chapter.

Chapter 2

Language Material

The language material for the experiments described in the following is based on 200 critical sentences, with 50 items in four different conditions. To construct these 200 sentences, accusative- or dative- assigning verbs were combined with an animate subject and an either inanimate or animate object. All critical sentences are grammatical, verb-final sentences with subject-object-verb word order.

The arguments are bare plural NPs. The argument NPs chosen do not carry overt morphological case marking in their plural forms, so neither case marking nor number agreement on the verb allow grammatical role assignment. In the condition with animate subjects and inanimate objects, the animacy contrast between both NPs still allows assigning grammatical roles to the arguments. The conditions with animate objects, on the other hand, are (theoretically) ambiguous: Both arguments are animate, and both could be the grammatical subject of the verb without violating the verb's selectional restrictions for animacy. However, this would change the word order of the embedded clause to to object-subject-verb. While OSV word order is grammatical in German, it is pragmatically marked. Without any context information, an NP - NP - VERB sequence is usually interpreted as following the canonical German SOV word order for subordinate clauses.

An adverb was inserted between the object NP and the critical verb to allow some time for the processing of object animacy before the verb class became available.

The dative-assigning verbs were selected from a list of German dative-assigning

two-place verbs provided in Meinunger (2007). To avoid confusion between the processing of non-standard case marking and non-standard word order, I did not include verbs with unmarked DAT-NOM word orders resembling object experiencer verbs like *gefallen* "to please" (McFadden 2004's *gefallen*-class of high dative-assigning verbs). Instead, I only chose noncanonical case marking verbs with the unmarked word order NOM-DAT. This group includes both verbs assigning high datives like *gehorchen* "to obey" and low datives (like *folgen* "to follow" and *ausweichen* "to avoid"), which are usually subsumed under the label "active dative verbs" in the psycholinguistic literature (see the Introduction, e.g. page 16, for further details.)

The accusative-assigning verbs were chosen for matching frequency and roughly, length, and also so that possible subject-object combinations would make sense with both the matching accusative- and dative-assigning verb. All dative- and accusative-assigning verbs semantically allowed animate subjects and both inanimate and animate objects.

Both the group of accusative- and dative-assigning verbs included morphologically simple verbs (*mögen* ''to like', *folgen* 'to follow') and verbs that have a separable preposition as a prefix (*anglotzen* 'stare at', *nachglotzen* 'stare after'). 20 of the dative-assigning verbs and 14 of the accusative-assigning verbs had separable prepositions. The exact percentage of verbs with and without prepositions depends on the choice of sentences and on how many of which verb pairs were repeated with different subjects and objects in the specific experiments (see the chapters of the experiments for details on the choice of stimulus material). Following the pattern outlined above, I constructed 50 critical sentence quartets, combining 37 animate subject NPs, 42 inanimate and 38 animate object NPs and 38 verb pairs. To construct 50 quartets, I repeated some verbs with different subject and object NPs, and also repeated some of the subject and object NPs with different verbs.

The subject-object-adverb-verb sequences were embedded as subordinate clauses into a matrix sentence. The matrix sentence had the function of making the SOV word order grammatical. It also provided words before and after the critical sentence to avoid sentence onset and wrap-up effects (see, for example, Just and Carpenter 1980 or Rayner et al. 2000). The matrix sentence also provided a con-

text wherein the critical embedded sentences were about someone's utterances, opinions, impressions or beliefs.

For brevity's sake, I will refer to the two conditions with accusative- or dative-assigning verbs as two verb classes (accusative or dative) in the following. I will call the two object animacy conditions inanimate and animate.

Example 1 Example of a typical sentence quartet. Note that case morphology is not overtly marked on the arguments.

(A) inanimate object, accusative-assigning verb:

Tim glaubt, dass Tauben Luftballons gerne mögen, und Tom
Tim believes that dove.PL.(NOM) airballoon.PL.(ACC) gladly like.3PL and Tom
glaubt das auch.
believes that too

Tim believes that doves rather like balloons, and Tom believes that, too.

(B) animate object, accusative-assigning verb:

Tim glaubt, dass Tauben Krähen gerne mögen, und ...
Tim believes that dove.PL.(NOM) crow.PL.(ACC) adv like.3PL and ...

Tim believes that doves rather like crows, and ...

(C) inanimate object, dative-assigning verb:

Tim glaubt, dass Tauben Luftballons gerne folgen, und ...
Tim believes that dove.PL.(NOM) airballoon.PL.(DAT) adv follow.3PL and ...

Tim believes that doves like following balloons, and ...

(D) animate object, dative-assigning verb:

Tim glaubt, dass Tauben Krähen gerne folgen, und ...
Tim believes that dove.PL.(NOM) crow.PL.(DAT) adv follow.3PL and ...

Tim believes that doves like following crows, and ...

An example of a typical sentence quartet is given in Example 2. The full list of all 200 critical sentences and all filler sentences is given in the Appendix 6.4. To avoid systematic frequency effects related to individual words influencing the comprehension process, the animate and inanimate object NPs in a sentence quartet were controlled for length ($t(78) = 1.22$, $p > .2$) and frequency ($t(74) = .61$, p

>.5; frequencies unavailable for four object nouns) according to the dlex corpus (Heister et al., 2011). The accusative- and dative-assigning verbs in a sentence quartet were also controlled for length ($t(74) = -.18$, $p > .8$) and frequency ($t(73) = 1.23$, $p > .2$, frequency unavailable for one verb) according to the dlex corpus. In all four experiments, comprehension questions were asked to provide the participants with a task and keep them alert and motivated. The number of questions asked was different for each experimental technique and is specified in the Procedure section of the respective chapters. The questions were worded so that they only had one correct answer. For example, questions like "Does Tim believe that doves like following crows?" demanded the answer 'yes'. Questions demanded the correct answer 'no' because one word was exchanged compared to the critical sentence. The exchanged word could be the subject NP ("Does Tim believe that *airplanes* like following crows?"), the object NP ("Does Tim believe that doves like following *cows*?"), the critical verb ("Does Tim believe that doves like *killing* crows?"), the matrix sentence verb ("Does Tim *deny* that doves like following crows?" or personal names ("Does *Daniel* believe that doves like following crows?") . The questions did not concern the thematic relationship of the arguments in the critical sentences ("Did NP1 verb NP2 (or vice versa)?"). I did not systematically ask question like this to avoid affecting the participants' reading behaviour. Therefore, the response data do not answer questions about the probability of making mistakes in the different conditions, and cannot provide additional insights for the research question at hand.

In all but the first experiment, the critical sentences were interspersed with filler sentences. The filler sentences were added to prevent syntactic priming (Bock, 1986; Branigan et al., 2000; Frazier et al., 1984; Ledoux et al., 2007); to keep the participants from developing reading strategies, and to avoid their becoming bored. Representative examples of filler sentences are

- *Um Konserven zu öffnen, benutzt Maria einen Dosenöffner oder ein Taschenmesser.* ("To open cans, Maria uses a can opener or a pocket knife")

- *Obwohl Susanne nicht Skifahren kann, verbringt sie ihre Ferien gerne in den Bergen.* ("Although Susanne cannot ski, she likes to spend her holidays in the mountains.")

- *Dass Nilpferde Krokodile töten, begeistert den Regisseur, aber nicht den Tierarzt.* ("[The fact] that hippopotamuses kill crocodiles delights the director but not the vet.")

In a preliminary acceptability study, the target sentences were rated online by 351 German native speakers (mean age was 25,1 years, 124 participants were male) using a 6-point scale with 1 the best and 6 the worst rating (similar to the grade system in German schools, which can be assumed to be familiar to all native speakers. Importantly, a rating of five or six implies that a sentence 'does not pass', whereas any better judgment means that the sentence is acceptable.). Sentences with animate objects were rated worse than sentences with inanimate objects (inanimate-accusative = 3.7, SD= .2, animate-accusative = 3.8, SD = .2; inanimate-dative=3.7, SD=.2; animate-dative=3.8; SD = .2), perhaps reflecting their being more ambiguous than the animate-inanimate sentences. This main effect of object animacy was small but significant ($F(1,48) = 7.5$, $p \leqslant .01$, two-way ANOVA of means over items). Importantly for this study, there was no effect of verbal case marking pattern and no interaction between verb class and object animacy in the acceptability ratings.

The final stimulus list presented in each experiment was constructed from this pool of stimulus material. However, the specific choice of sentences, randomisations and the number of filler sentences varied between experiments to meet the requirements of the experimental technique used. The choice of critical sentences and the randomisation procedures will be explained in the chapters describing the experiments.

As outlined in the introduction, the hypothesis to be tested in the experiments is that verb class and object animacy interact during sentence comprehension. I expect animate objects to cause higher processing costs than inanimate objects, and I expect that this effect of object animacy is modulated by on the verbal case marking pattern. Based on the psycholinguistic literature (Frisch and Schle-

sewsky, 2001; Grewe et al., 2007; Trueswell et al., 1994; Weckerly and Kutas, 1999), I expect higher processing costs in the animate-accusative than in the inanimate-accusative condition, leading to longer reading times and measurable ERP deflections in the animate-accusative condition. The contrast between the animate-dative and the inanimate-dative conditions, on the other hand, should be different from the contrast between the two accusative conditions, showing a less pronounced influence of object animacy[1].

[1]The expected main effect of object animacy in the accusative conditions serves as a control: If the presence of two animate argument NPs is enough to trigger measurable object animacy effects, this proves that the experimental method chosen is sensitive enough to detect increased processing costs resulting from difficulties in thematic role assignment (even in the absence of semantic violations) with the stimulus material presented here. Any additional effects supporting my hypothesis (and any lack of additional effects) can then be discussed in relation to this control condition.

Chapter 3

Self-paced reading time study

Summary

The self-paced reading time study served as a pre-experiment to the later experiments, and was aimed to test the adequacy of my stimulus material for my research question.

The results of this first experiment showed that the stimulus material was indeed useful to answer questions about sentence comprehension: There was a statistically significant increase of reading times in the animate compared to the inanimate condition for adverbs and verbs. This proves that in our stimulus material, animate objects measurably increase comprehension difficulty, in line with previously observed effects of object animacy. In addition to this control effect, I found a small but statistically significant interaction between object animacy and verb class on the first postverbal word. This interaction supports my hypothesis, indicating that the processing of argument animacy contrasts is modulated once verb class information becomes available. Therefore, the self-paced reading time study gave the first experimental evidence supporting the initial hypothesis, and suggested to continue the planned course of experiments with the original stimulus material.

3.1 Experiment 1: Self-paced reading time study

Participants 30 participants were recruited via the Humboldt University's experimental participant recruitment service (PESA). All participants spoke German as their only native language, had no known reading or language-related problems and had normal or corrected to normal vision. All participants gave written and informed consent. Each participant received 7 Euros recompensation.

Procedure The language material for the first study consisted of all 200 critical sentences given in Appendix 6.4. The sentences were presented in a masked, word-by-word non-cumulative fashion. Sentence presentation started, e.g., with quartet 1 - condition (A), continuing with quartet 2 - condition (B), then quartet 3 - condition (C) etc. until all 200 sentences had been presented. Every participant started with a different sentence so that no two participants saw the same list. The order of sentence quartets was pseudorandomised so that no words were repeated in two following sentences. The experiment began with a training session consisting of five practice sentences, with the last two sentences resembling the stimuli. All participants saw all sentences. To keep the participants alert during the experiment and to provide them with a task, a comprehension question was asked after each sentence, following the pattern described in Chapter 2 (see page 34). Participants answered the questions with key presses for 'yes' or 'no' and received feedback on whether their answers were correct. The stimuli were presented and reaction times were measured using Linger (Rohde, 2003).

Data analysis Reading times for the words in a sentence were excluded from the calculations if the question concerning that sentence was answered wrongly. This concerned 17,08 % of the originally recorded data. After the removal of the sentences with wrongly answered questions, the average reading times in the four conditions were calculated separately for each participant. For every single word position in the sentence, reading times that deviated by more than two standard deviations from a participant's condition mean were coded as outliers and removed. The remaining dataset contained 79% of the originally recorded data.

From this dataset, the mean reading times for single words were calculated over participants and in a second analysis over items for each word position from the subject until the postverbal *und*. Repeated measures ANOVAs with within-subject factors (within-items factors for the F_2 analysis, respectively) object animacy and verb class were performed on the logarithmized mean reading times.

3.2 Results

Reading times for all words of the critical sentence are given in Table 3.1. Here, we report only statistically significant effects, with the exception of the reading times for subjects and objects. An overview of the results of all statistical calculations for Experiment 1 is given in Appendix 2 in Table 1.

subject: There were no significant effects of object animacy ($F_1(1,29) = 1.84$, $p > .1$; $F_2(1,49) = 1.87$, $p > .1$) or verb class (($F_1(1,29) = 1.1$, $p > .2$), $F_2(1,49) < 1$) and no interactions (both Fs < 1) on the subject position.

object: There was a statistically significant effect of object animacy in the F1 analysis, but it did not reach significance in the F2 analysis ($F_1(1,29) < 4.27$, $p < .05$; $F_2(1,49) < 1$, $p > .3$). There were no effects of verb class (both Fs < 1) and no interactions ($F_1(1,29) = 2.6$, $p > .1$; $F_2(1,49) = 1.87$, $p > .1$).

adverb: Reading times for adverbs were significantly shorter in the inanimate than in the animate condition ($F_1(1,29) = 14.34$, $p < .001$; $F_2(1,49) = 20.88$, $p < .001$). *critical verb:* Reading times for critical verbs were significantly shorter in the inanimate than in the animate condition ($F_1(1,29) = 10.42$, $p < .01$); $F_2(1,49) = 22.52$, $p < .001$).

first postverbal word: On the first postverbal word, there was an interaction between object animacy and verb class. This interaction was marginally significant in the F1 analysis, and significant in the F2 analysis ($F_1(1,29) = 3.68$, $p < .07$ $F_2(1,49) = 9.95$, $p < .01$). The simple main effect of object animacy was statistically significant in the accusative conditions ($F_1(1,29) = 8.43$, $p < .01$; $F_2(1,49) = 11.69$, $p < .01$), but not in the dative conditions $F_1(1,29) < 1$, $p > .5$; $F_2(1,49) < 1$, $p > 0.3$). The first postverbal word in the matrix sentence, *und*, was read faster

	position				
condition	subject	object	adverb	verb	postverbal
inanimate accusative	495 (28)	539 (29)	477 (21)	608 (46)	403 (16)
animate accusative	495 (29)	520 (30)	502 (24)	656 (53)	416 (17)
inanimate dative	501 (29)	527 (29)	479 (21)	629 (49)	415 (17)
animate dative	490 (28)	528 (33)	498 (24)	670 (57)	411 (15)

Table 3.1: Self-paced reading times, mean reading times over participants in ms (standard error of mean in parentheses)

after an inanimate object than after an animate object in the accusative-assigning condition(403 ms vs 416 ms). This effect of object animacy was not visible in the dative-assigning condition (415 ms vs 411 ms). In addition to the interaction effect, there also was a main effect of object animacy on the first postverbal word *und*. This effect was marginally significant in the F_1 analysis, but was not significant in the F_2 analysis ($F_1(1,29) = 4.0$, $p<.1$, $F_2(1,49) = 1.94$, $p > 0.1$).

3.3 Discussion

Main effects of object animacy: The results of the study show robust main effects of object animacy, both for sentences in the accusative and in the dative condition. Reading times for adverbs and critical verbs were longer if the objects of the sentences were animate than if they were inanimate. I interpret these longer reading times as indicating higher processing costs for the animate conditions. This main effect of object animacy fits the expectations formulated above, and is in line with findings from the literature (Frisch and Schlesewsky, 2001; Grewe et al., 2007; Trueswell et al., 1994; Weckerly and Kutas, 1999). This main effect of object animacy was already measurable on the adverb, indicating the incremental build-up of a sentence context using animacy information.

Main effects of verb class: There were no statistically significant effects of verb class.

Interaction between object animacy and verb class: On the first postverbal

word *und*, there is a statistically significant interaction between object animacy and verb class for the reading times of this position. In the accusative condition, the reading times for *und* are longer after an animate than after an inanimate object. The influence of object animacy is thus the same that it was on the two preceding words. In the dative condition, however, there is no statistically significant difference between the reading times for the postverbal *und* in the animate and inanimate conditions.

This interaction effect supports our initial hypothesis, indicating that the object animacy effect on sentence processing is indeed affected by the processing of verb class information. The difference between the object animacy effects in the accusative and dative conditions is visible once verb class information has become available (i.e., once the critical verb has been read).
In the General Discussion (see Chapter 6), I will offer some suggestions for the linguistic mechanisms possibly underlying this interaction. Here, I will discuss the experimental method and its possible influence on the time course of the effects, i.e., why the interaction effect was only visible on the postverbal *und*, not on the critical verb.

One possible explanation is that the interaction between object animacy and verb class reflects a late processing step (e.g., beginning reanalysis) that only happens while the participants have already pressed the key to read the next word. While this makes sense given the results of the self-paced reading time experiment, the results of the remaining experiments presented in Chapters 4 and 5 do not support this interpretation of the current study.

Another possibility is that the time course of the effects is influenced by the unnatural reading paradigm. In non-cumulative reading, all the words have to be memorised while the next words are presented in order to build a representation of the whole sentence (and, in this experiment, to be able to answer the questions). The high memory workload might delay the processing of a word and its integration into the sentence context, so that the reading times of the following words are affected and the measures of increases in processing cost spill over onto the next words.

Another possible explanation is that the readers perform only the access to

the lexical information of the verb during the reading time of the verb. Then, after having pressed the key to see the next word, they incrementally integrate the verb into the sentence context, while at the same time they perform the access to the postverbal *und*. Under this explanation, it is quite natural for the reading time of a given word to be affected by the syntactic and semantic properties of the preceding words, together with its own lexical properties, without having to assume an influence of memory workload.

Irrespective of the explanation for the time course of the interaction effect chosen, the results illustrate the fact that compared to eyetracking and ERP measurements (used in the experiments described in Chapters 4 and 5), self-paced reading times are a 'late' measure. Another example for this is the time course of the main effect of object animacy, which is statistically significant in both the F_1 and F_2 analyses only on the adverb, but not on the object NP.

This first experiment suports my initial hypothesis. However, some critical points remain that I will adress here. The interaction occurred on the first postverbal word (*und*). This a very short function word that always appeared at the same position in the critical sentences, and therefore had rather short reading times in general. I assume that after the first few sentences, the participants in the experiments were accustomed to the sentence pattern and therefore pressed the key quite mechanically when this small, highly predictable word appeared on the screen. This might have shortened the reading times for *und*, making it more difficult to interpret effects found at this position.

The critical sentences were not interspersed with filler sentences in this first experiment. I assumed that the response data would indicate if participants became bored and did not read (and therefore comprehend) the sentences properly. This assumption might have been too optimistic, as the absence of filler sentences might still have contributed to some kind of syntactic priming. Reading a sequence of very similar sentences certainly did cause weariness with the participants.

However, if syntactic priming occurred, it should have affected all conditions, and its effects would have been evenly distributed because of the pseudorandomisation method chosen. I do therefore not assume that the interplay between

object animacy and verb class visible in the results can be explained as a spurious interaction effect caused by the lack of true randomisation and filler sentences. However, it is possible that the monotony of reading the same sentence pattern again and again could have weakened both the effects of object animacy and the interaction.

3.4 Conclusion

The results of the self-paced reading time study supported the choice of stimulus material and the initial hypothesis. Therefore, the same stimulus sentences were used in the eyetracking and ERP studies. To exclude the possibility of syntactic priming, the critical sentences were interspersed with filler sentences in the following experiments, and different randomisation methods were chosen.

Chapter 4

Eyetracking studies

Summary

In this chapter, I report two eyetracking studies. In the first eyetracking study, I monitored eye movements in natural reading. The results of this study show an interaction between object animacy and verb class on the first-pass times of the preverbal adverb. While the existence of an interaction is predicted by the initial hypothesis, it is visible at a remarkably early point in time, just before the first fixation of the verb. This early interaction can only be explained in models of reading that allow a high amount of parallelism, and suggests that the interaction reflects a parafoveal-on-foveal effect. The existence of these effects is still controversial in eye movement research, and is usually tested with sentence material that is specifically tailored to these experiments.

To make sure that the interaction does indeed reflect a parafoveal-on-foveal effect, and not some problems with the eyetracking equipment, I performed a second eyetracking study. In this study, I presented the stimulus sentences in a boundary paradigm, which prevents the use of parafoveal information. The results of this second eyetracking experiment showed no interaction between object animacy and verb class. This finding supports my assumption that the interaction in the first experiment indeed reflects parafoveal processing.

4.1 Eye movements in natural reading

The self-paced reading time study presented in Chapter 3 provided the first support for the initial hypothesis, showing an interaction between object animacy and verb class during sentence comprehension. In the experiment presented below, I tested the initial hypothesis in an eyetracking experiment. This method allows to monitor the participants' natural reading behaviour (in contrast to the rather unnatural word-by-word-presentation employed in self-paced reading) and offers a number of different reading behaviour measures for analysis.

4.1.1 Experiment 2.1: Natural reading

Participants 54 participants were recruited via the Humboldt University's experimental participant recruitment service (PESA). All participants spoke German as their only native language, had no known reading or language-related problems and had normal or corrected to normal vision. All participants gave written and informed consent. Two participants were excluded because they moved their heads during the experiment. The mean age of the remaining sample was 26,1 years. 20 of the 52 participants included in the study were male. The participants received 10 Euros recompensation.

Procedure The language material for both eyetracking studies included all 200 critical sentences. In the preceding self-paced reading time study (see Chapter 3), a small number of matrix sentences had contained reflexive verbs (*Peter wundert sich, dass...*, "Peter wonders [about the fact] that..."). For the eyetracking study, the verbs in these matrix sentences were changed to nonreflexive verbs (*Peter staunt, dass...*, "Peter is amazed that...") with similar meanings. This change was necessary to evaluate the eyetracking data based on word positions.

For the eyetracking experiments, I created four different sets of sentences. Each set contained only one sentence of each sentence quartet (i.e., quartet 1 - condition (A), quartet 2 - condition (B), etc.), interspersed with 75 filler sentences of all three types described in Chapter 2). The sets were pseudorandomised into two versions, resulting in eight different stimulus lists. Each participant saw

one of these eight stimulus lists, containing 50 critical sentences counterbalanced between the four different conditions (i.e., each participant saw 12 sentences of two conditions and 13 sentences of the other two conditions). The critical sentences were divided into different sets and interspersed with filler sentences to avoid syntactic priming and to prevent participants from developing reading strategies. Another reason for presenting only a quarter of the stimulus material was the need to limit the length of an experimental session to a maximum of 40 minutes, since in longer sessions the participants would have risked experiencing headaches from the weight of the head-mounted eyetracker.

The participants' eye movements were tracked using the Eyelink I head-mounted eyetracking system of SR Research with a sample rate of 250 Hz. The position of the participants' right eye was used for measurements. The SR Research Experiment Builder software was used to program the experiment. The sentences were presented on a 1024x768 screen. Before the start of the experiment, a 9-point calibration was performed. During the experiment, a drift correction was performed before every 10th sentence, using a point displayed at the center of the screen.

The experiment started with a practice session consisting of six sentences with questions, two of which resembled the filler sentences, and continued with the randomised stimulus list. Before the presentation of each sentence, a fixation cross was presented at the position of the first word for 1500 ms. Sentences were presented as whole sentences in a single line in a sans-serif font (Arial 16 pt). Participants pressed a key on a Cedrus RB 830 response pad to indicate they had read and understood the sentence.

To keep the participants' attention and provide them with a task apart from reading, a comprehension question was asked after about one tenth of the sentences at intervals between eight and 12 sentences. The questions were similar to the ones described in Chapter 2 and concerned both the critical sentences and the fillers. The participants answered the questions by pressing one of two keys on the Cedrus RB 830 response pad for 'yes' or 'no'. The participants were instructed to rest their eyes before answering the questions and to take breaks whenever needed.

I report the following measures (following Ferrara Boston et al., 2008) from

the area of interest around the individual words in the sentences:

First pass reading time: The time spent from entering the region of interest around a word from the left for the first time until leaving this region of interest either to the left or right. This measure reflects text integration. It also includes the first fixation durations, which reflect word recognition.

Regression path duration: The time spent from entering the region of interest around a word from the left for the first time until the first fixation to the right of the region of interest, thus adding possible regression times to the first pass reading time. This measure reflects integration difficulty of the word into the unfolding sentence context.

Total reading time: The sum of all fixation times spent on the region of interest. This measure reflects general comprehension difficulty.

Data analysis The data were processed using the SR Research EyeLink Data Viewer. Before data analysis, all fixations shorter than 50 ms were removed from the raw data.

Observations that deviated from a participant's or an item's mean by more than two standard deviations were coded as outliers and removed. Depending on the reading time measure, 4.1 % to 5.2 % of the data were removed as outliers. Reading times are reported as condition means for participants or items in ms. Normalised reading times are calculated for each of the described reading time measures as the proportion that this measure contributes to the overall reading time of the respective sentence when read by the respective participant. Unlike in the first experiment, reading time measures for the first postverbal position were not taken into account, because skipping behaviour for this very short and predictable word differed too much between the single participants for statistical analyses. Two-way ANOVAs were performed with both logarithmised reading times and logarithmised normalised reading time in R (R Development Core Team, 2005). A table reporting the results of all statistical calculations for Experiment 2.1 is given in Table 2 and Table 3 in Appendix 2.

measure	condition	position			
		subject	object	adverb	cverb
First pass time	inanim acc	323 (14)	356 (20)	278 (10)	323 (13)
	anim acc	324 (16)	321 (15)	297 (15)	321 (13)
	inanim dat	313 (15)	353 (18)	276 (10)	327 (12)
	anim dat	324 (15)	323 (13)	274 (9)	337 (13)
Regression path duration	inanim acc	351 (14)	415 (24)	308 (12)	385 (17)
	anim acc	356 (17)	388 (18)	337 (15)	430 (19)
	inanim dat	346 (16)	408 (22)	312 (14)	430 (16)
	anim dat	354 (14)	392 (17)	332 (18)	485 (24)
Total reading time	inanim acc	570 (28)	602 (30)	400 (17)	413 (16)
	anim acc	608 (30)	593 (30)	442 (20)	430 (20)
	inanim dat	527 (26)	586 (31)	421 (20)	446 (16)
	anim dat	601 (30)	579 (28)	440 (20)	478 (23)

Table 4.1: Eye movement measures for Experiment 2.1, means over participants in ms (standard error of mean in parentheses)

4.1.2 Results

Means of reading time measures for Experiment 2.1 are given in Table 4.1 for unnormalised reading time measures and Table 4.2 for normalised reading time measures. Only statistically significant effects are reported, unless indicated otherwise. If the reported effects apply to both unnormalised and normalised data, the given statistical values are for normalised data. An overview of the results of all statistical calculations for Experiment 2.1 is given in the Appendix 2 in Table 2 on page 152 for unnormalised data and in Table 3 on page 153 for unnormalised data.

First pass times

First pass times for Experiment 2.1 are illustrated in Figure 4.1.

Object NPs: There was a statistically significant main effect of object animacy on the object position ($F_1(1,51) = 14.96$, $p < .001$, $F_2(1,49) = 7.542$, $p < .01$). First pass times for objects were shorter for animate than for inanimate objects.

Adverbs: There was a main effect of verb class on the adverb position. This main effect of verb class was statistically significant for normalised data ($F_1(1,51) = 6.24$, $p < .05$, $F_2(1,49) = 4.93$, $p < .05$), and marginally significant for unnor-

measure	condition	position			
		subject	object	adverb	cverb
First pass time	inanim acc	7.3 (0.2)	8.2 (0.3)	6.4 (0.2)	7.5 (0.2)
	anim acc	7.4 (0.3)	7.4 (0.2)	6.9 (0.2)	7.5 (0.3)
	inanim dat	7.3 (0.3)	8.2 (0.3)	6.4 (0.3)	7.7 (0.2)
	anim dat	7.2 (0.3)	7.2 (0.3)	6.3 (0.2)	7.6 (0.3)
Regression path duration	inanim acc	8.0 (0.3)	9.4 (0.4)	7.2 (0.3)	8.8 (0.3)
	anim acc	8.1 (0.3)	8.9 (0.3)	7.9 (0.3)	10.0 (0.4)
	inanim dat	8.0 (0.3)	9.4 (0.3)	7.2 (0.3)	9.9 (0.3)
	anim dat	7.8 (0.3)	8.7 (0.3)	7.4 (0.3)	10.5 (0.3)
Total reading time	inanim acc	12.3 (0.4)	13.1 (0.4)	8.8 (0.2)	9.5 (0.3)
	anim acc	13.3 (0.5)	12.9 (0.4)	9.9 (0.3)	9.6 (0.2)
	inanim dat	11.6 (0.4)	12.9 (0.5)	9.3 (0.3)	10.1 (0.3)
	anim dat	12.6 (0.4)	12.2 (0.4)	9.4 (0.3)	10.3 (0.3)

Table 4.2: Normalised eye movement measures for Experiment 2.1, mean proportions over participants in percent (standard error of mean in parentheses)

malised data ($F_1(1,51) = 3.42$, $p < .1$, $F_2(1,49) = 2.92$, $p < .1$). First-pass times were longer in the accusative than in the dative condition.

In addition to the main effect of verb class, there was an interaction between object animacy and verb class. This interaction was statistically significant for normalised data ($F_1(1,51) = 6.29$, $p < .05$, $F_2(1,49) = 6.23$, $p < .05$), and marginally significant for non-normalised data ($F_1(1,51) = 3.45$, $p < .1$, $F_2(1,49) = 4.0$, $p < .1$). First pass times for adverbs following an animate object were longer than first pass times for adverbs following inanimate objects in the accusative condition, but not in the dative condition. The simple main effect of object animacy was significant in the accusative condition ($F_1(1,51) = 6.152$, $p < .05$, $F_2(1,49) = 5.06$, $p < .05$), but not in the dative condition ($F_1(1,51) = 1.22$, $p > .2$, $F_2(1,49) = 0.7$, $p > .3$).

Regression path durations

Adverbs: There was a main effect of object animacy at the adverb position. This main effect of object animacy was statistically significant for unnormalised data ($F_1(1,51) = 8.44$, $p < .01$, $F_2(1,49) = 4.33$, $p < .05$), and marginally significant for normalised data in the F_1 analysis ($F_1(1,51) = 3.81$, $p < .6$, $F_2(1,49) = 2.47$, $p > .1$) Regression path durations were longer in the animate than in the inanimate conditions.

Critical verbs: There was a statistically significant main effect of object animacy ($F_1(1,51) = 13.53$, $p < .001$, $F_2(1,49) = 6.66$, $p < .05$) and a statistically significant main effect of verb class ($F_1(1,51) = 8.90$, $p < .001$, $F_2(1,49) = 10.09$, $p < .01$). Regression path durations on the critical verbs were longer after an animate object than after an inanimate object, and were longer in the dative than in the accusative condition.

Total reading times

Subject NPs: There was a statistically significant main effect of object animacy ($F_1(1,51) = 11.39$, $p < .01$, $F_2(1,49) = 15.75$, $p < .001$), with total reading times on subject NPs being significantly shorter in inanimate than animate conditions. For normalised data only, there also was a main effect of verb class (statistically significant in the F_1 analysis, but marginally significant in the F_2 analysis, $F_1(1,51) = 4.96$, $p < .05$, $F_2(1,49) = 3.65$, $p < .7$), with normalised total reading times being shorter in the dative than in the accusative conditions. For unnormalised data, there also was a marginally significant interaction between object animacy and verb class ($F_1(1,51) = 2.84$, $p < .1$, $F_2(1,49) = 3.22$, $p < .08$). The simple main effects of object animacy were significant or marginally significant for both verb classes (accusative: $F_1(1,51) = 3.71$, $p < .06$, $F_2(1,49) = 4.13$, $p < .05$; dative: $F_1(1,51) = 14.49$, $p < .001$, $F_2(1,49) = 16.61$, $p < .001$). Total reading times were shorter for inanimate than animate conditions in the accusative condition, and much shorter for inanimate than animate conditions in the dative condition. This interaction effect was not visible for normalised data.

Object NPs: For normalised data only, there was a main effect of verb class that was statistically significant in the F_1 analysis, and marginally significant in the F_2 analysis ($F_1(1,51) = 4.35$, $p < .05$, $F_2(1,49) = 3.38$, $p < .08$). Normalised

total reading times for objects were shorter in the dative than in the accusative condition. This effect of verb class was not significant for unnormalised data.

Adverbs: Total reading times on adverbs were significantly shorter in the inanimate than in the animate conditions ($F_1(1,511) = 8.101$, $p < .001$, $F_2(1,49) = 6.294$, $p < .05$). For normalised data only, there was an interaction between object animacy and verb class. This interaction was statistically significant in the F_1 analysis, and marginally significant in the F_2 analysis ($F_1(1,51) = 6.68$, $p < .05$, $F_2(1,49) = 2.92$, $p < .1$). The simple main effect of object animacy was statistically significant in the accusative conditions ($F_1(1,51) = 13.27$, $p < .001$, $F_2(1,49) = 9.35$, $p < .01$), but not in the dative conditions ($F_1(1,51) < 1$, $p > .5$, $F_2(1,49) < 1$, $p > .3$)

Critical verbs: There was a main effect of verb class ($F_1(1,51) = 12.47$, $p < .001$, $F_2(1,49) = 7.07$, $p < .05$). Total reading times for critical verbs were shorter in the accusative than in the dative condition. For unnormalised data only, there also was a main effect of object animacy that was marginally significant ($F_1(1,51) = 3.31$, $p < .08$, $F_2(1,49) = 3.63$, $p < .07$). Normalised reading times were slightly shorter in the accusative than in the dative conditions.

4.1.3 Discussion

Main effects of object animacy: The first pass times for animate NPs were shorter than the ones for inanimate NPs matched for length and frequency. I interpret this first effect of object animacy as reflecting the different accessibility of animate and inanimate referents. This interpretation suggests that the first processing steps (like word recognition) are less costly for animate NPs than for inanimate NPs. However, integrating the animate NPs as objects into a transitive sentence context is more costly than integrating inanimate NPs as objects, as is reflected in later measures.

The regression path durations on the adverb and the critical verb and total reading times for subjects, and unnormalised total reading times for adverbs were longer in sentences with animate subjects and objects. These effects of object

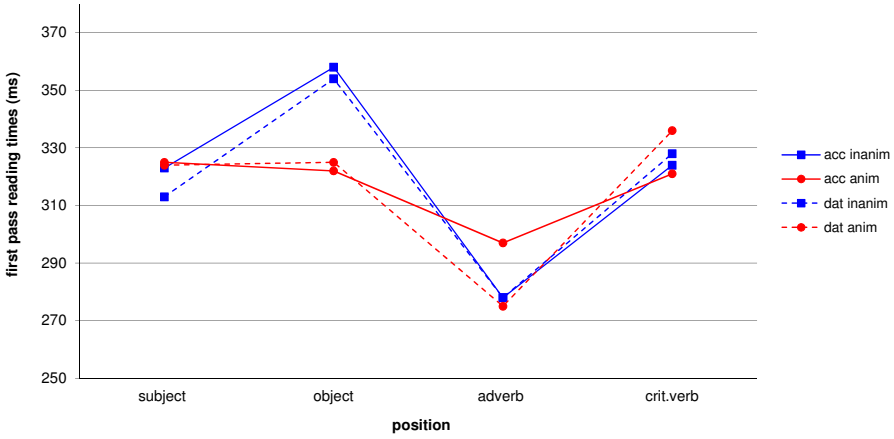

Figure 4.1: First pass times in Experiment 2.1 on single word positions, means over participants in ms.

animacy hold for both verb classes. Taken together, these main effects of object animacy indicate that two animate arguments cause higher processing costs than one animate and one inanimate argument. This additional processing cost for animate instead of inanimate objects fits the object animacy effects described in the literature (Frisch and Schlesewsky, 2001; Grewe et al., 2007; Trueswell et al., 1994; Weckerly and Kutas, 1999).

Main effects of verb class: Verbs assigning dative case had higher processing costs than verbs assigining accusative case. This was indicated by longer regression path durations and longer total reading times on dative verbs compared to accusative verbs matched for length and frequency. These reading time measures reflect higher integration difficulty and general comprehension difficulties for the dative compared to the accusative conditions. This effect of verb class is in line with the literature. Higher processing costs for dative than for accusative assigning verbs have been reported from both behavioural and ERP experiments before (Bader et al., 2000; Hopf et al., 1998).

The early main effect of verb class and the interaction between object animacy and verb class on the adverb position (see below) suggests that verb class information is accessed quickly and influences both early and late processing steps.
On the subject and object position, the normalised total reading times were shorter in the dative than in the accusative condition. This effect was not significant for unnormalised reading times.

Interaction effects of object animacy and verb class: There was a statistically significant interaction between object animacy and verb class, visible on the first pass times on the adverb position. In the accusative condition, the first pass times for adverbs were longer after animate than after inanimate objects. I interpret this as reflecting the higher processing costs caused by two non-case-marked NPs in the sentence, indicating that at this point in time, the integration of both NPs into an unfolding sentence context has begun.
This effect of object animacy was only visible in the accusative condition. In the dative condition, the first pass times on adverbs were equal to the inanimate-accusative condition, and were not influenced by object animacy.

(For normalised total reading times (but not for unnormalised total reading times), this interaction also was significant. I interpret the interaction for the normalised total reading times as reflecting the contribution of the normalised first pass times to this reading time measure.)

The interaction effect visible in the first pass times supports my initial hypothesis that the verbal case marking pattern modulates object animacy effect. Interestingly, the interaction between verb class and object animacy is visible during the *first pass times* on the adverb. At this point in time, the participants had not directly fixated the verb yet. This raises the question how the verbal case marking pattern could have influenced the processing of object animacy before the participants had even looked at the critical verb. One explanation for this rather early position and point in time for the interaction effect is parafoveal processing. This means that while the participants' gaze was still on the adverb, the beginning of the verb was already in the participants' right parafoveal field of vision. Therefore, the participants already had access to some information about the verb and could start processing verb class information before directly fixating

the verb.

In the following, I will give a short overview over the use of parafoveal information in natural reading. After this overview, I will present the second eyetracking experiment, which was aimed to check whether the interaction found really reflects parafoveal processing.

Parafoveal processing In natural reading, visual information from within about 1°of visual angle around the fixation point is projected onto the fovea. This is the region on the retina where vision is most acute. Visual information from within 5°of visual angle around the fixation point is projected onto the parafovea. In this region, vision is less acute than in the fovea. However, readers can still extract information about the words projected onto the parafovea (Staub and Rayner, 2007). The *perceptual span* is the region of a text around a fixation point where words can be successfully identified. The perceptual span is asymmetric (e.g., McConkie and Rayner, 1975), extending about 3-4 letters to the left, but at least about 7-8 letters to the right of the foveal region for readers of left-to-right-written languages like English (without accurate letter recognition even up to 14 or 15 letters to the right). Information from the parafoveal region (like general word shapes and the locations of gaps between words) is used to plan the next saccades in reading. In addition, parafoveal preview allows access to linguistic information about the upcoming words. (See Staub and Rayner, 2007, and Shillcock, 2007, for a review.)

Because of parafoveal preview, the processing of a word n+1 already starts while a reader's gaze is still fixated on the preceding word n in natural reading. This explains why the fixation time of word n+1 will be shorter (once it is fixated) in natural reading than if parafoveal preview of word n+1 is impossible during the fixation of word n (e.g., Hyönä et al., 1998). This shortening of fixation times due to parafoveal preview is called the *preview benefit*. The fixation times for word n, on the other hand, are also influenced by the parafoveal processing of word n+1. Fixation times for word n are longer when the processing of word n+1 is more costly, even before word n+1 is fixated. This 'backwards-directed' effect is called a *parafoveal-on-foveal effect*.

While the existence of preview benefits is generally accepted, the exact na-

ture of parafoveal information that can cause parafoveal-on-foveal effects is still unclear. Rayner et al. (2003) review a number of different studies finding evidence for and against the existence of parafoveal-on-foveal effects. The authors conclude that the evidence for the existence of parafoveal-on-foveal effects is not convincing. Rayner et al. (2004) found hints that the plausibility of a word in the parafoveal region influenced fixation times of the foveal word. However, they interpret their findings as reflecting other factors. The alternative explanations they suggest include discrepancies between the location of attention and the fixation point on the text, misguided saccades, and measurement mistakes due to imprecise eyetracker calibrations.

On the other hand, a number of studies support the existence of parafoveal-on-foveal effects in natural reading. Kennedy and Pynte (2005) discuss the literature on parafoveal-on-foveal effects, showing both a number of studies finding evidence for their existence, and a number of studies failing to replicate these findings. In their own study on parafoveal-on-foveal effects for long and short foveal words in reading English and French, they found evidence that parafoveal-on-foveal effects for short foveal words reflect the lexical frequency of the parafoveal word. For longer foveal words (8-12 letters), parafoveal-on-foveal effects reflect pre-lexical or sub-lexical properties of the parafoveal words, like initial-letter-constraints and orthographic familiarity. Kliegl et al. (2007) found both preview benefits and parafoveal-on-foveal effects in reading, suggesting that information from word n+1 and word n+2 is already accessible during the fixation of word n.

In addition to these early-processing related factors, some factors associated with later processing steps have been shown to cause parafoveal-on-foveal effects in sentence processing. These include phonology (Breen and Clifton, arch) and pragmatic plausibility of argument-verb-combinations (Kennedy et al., 2004). In their first experiment, Kennedy et al. (2004) presented transitive sentences consisting of NP1-verb-NP2-sequences. These sequences were either plausible combinations of arguments and verbs (baseline condition: *The savages smacked the child*), or either NP1 or NP2 were implausible in combination with the verb (*The savages smacked the money*; *The uranium smacked the child*) or completely implausible combinations of arguments and verbs (*The uranium smacked the money*). The authors found that the first pass reading times of NP1 were 20

ms longer when the combination of NP1 and verb was implausible (*The uranium smacked the child*) than in the plausible baseline condition. This plausibility effect only held if the following combination of verb-NP2 was plausible. On the position of the verb, Kennedy et al. found *shorter* first pass reading times for implausible combinations of verb-NP2 (*The savages smacked the money*) than for the baseline condition. This effect was only visible if the preceding NP1-verb-combination was plausible. The authors conclude that pragmatic plausibility of argument-verb combinations is already processed during parafoveal preview, and can lead to parafoveal-on-foveal effects in normal reading.

In sum, it appears that parafoveal-on-foveal effects can reflect the processing of linguistic information (in addition to the processing of purely visual information like word shapes). Therefore, I assume that the interaction between object animacy and verb class found during the first pass times on the adverb position is a parafoveal-on-foveal effect, reflecting the beginning of the processing of the verb. This verb class information influences the processing of the argument animacy contrasts that is already happening while the adverb is fixated in the first pass. Since many of the adverbs were rather short, it is not unlikely that the verbs are inside the parafoveal region during the fixation of the adverbs.

To make sure that the interaction between object and animacy found in the first eyetracking experiment does indeed reflect parafoveal processing (and not some experimental mistake), I repeated the experiment using the same stimulus material. For sentence presentation in this second eyetracking experiment, I used a boundary paradigm. This paradigm prevents parafoveal processing by masking the words until they are directly fixated. In this second experiment, I did not expect interactions between object animacy and verb class on the adverb position, since the verb class information was not accessible because of the masking.

4.2 Eye movements in a boundary paradigm

The results of the first eyetracking experiment suggest that verbal case marking patterns are already processed during parafoveal preview. While finding an interaction between object animacy and verb class supported my initial hypothesis, the interaction was visible at a remarkably early point in time. In a second eyetracking experiment, I tested whether this interaction could really be explained as the result of parafoveal processing. The stimulus material for this second eyetracking experiment was identical to the one for the first eyetracking experiment, but the sentences were presented to the participants in a boundary paradigm (Rayner, 1975). In a boundary paradigm, the text ist presented in a masked version. After the reader has crossed an invisible boundary with his gaze and has fixated a region of interest for a specified amount of time, the text is unmasked and displayed in its intended form. In this way, information about the word can only be accessed after the word has been fixated, and the fixation times on word n are sure to not reflect processing of word n+1. Usually, reading experiments using boundary paradigms are designed so that participants are not consciously aware of the display change. However, the average reading times using boundary paradigms are slower than in natural reading, showing the importance of parafoveal processing during natural reading (Rayner, 1998).

4.2.1 Experiment 2.2: Boundary paradigm

Participants 54 participants who had not participated in the preceding experiment were recruited via the Humboldt University's experimental participant recruitment service (PESA). The data from two participants were not included in the analysis. One was rejected because of head movements, one because of uncoordinated eye movements (a condition that the participant was unaware of and that might be related to preceding eye muscle surgery that the participant mentioned after the experiment). The remaining participants spoke German as their only native language, had no known reading or language-related problems and had normal or corrected to normal vision. All participants gave written and

informed consent. Mean age was 25,7 years, 16 of the 52 participants included in the study were male. The participants received 10 Euros recompensation.

Language material The language material and the randomisation of the stimulus lists was identical to Experiment 2.1 (using natural reading). However, I made one important change: adverbs shorter than four letters (like *oft*, "often") were replaced with adverbs with similar meaning, but at least 5 letters long (*häufig*, "often"). This change was necessary to ensure that the adverbs would be long enough and that a fixation inside the region of interest around the adverb would not accidentally fall on the region of interest around the verb, thereby unmasking the verb prematurely. In the boundary paradigm, the sentences appeared on the screen with words number 3 (*dass*, "that") to 8 (postverbal *und*, "and") replaced by nonsense letter strings of equal length and silhouette in all item and filler sentences (exchanging h with b, T with F etc.). The correct words were revealed after the participants had fixated the region of interest around the word for 5 ms with their left eye. When participants skipped words and fixated a word farther to the right, all the words to the left of the currently fixated word were unmasked together with the currently fixated one. Once unmasked, words did not revert back to their masked version. The stimuli were displayed in a true type font (Monotypewriter 13 pt) to minimize irritation during the display changes from masked to unmasked version.

Procedure The experiment was performed in the same laboratory using the same equipment as in the first eyetracking experiment. The sentences were presented as whole sentences in a single line. Data collection, processing and analysis were performed as described for the first eyetracking experiment, with the following changes: A Python-based plugin for realising the boundary paradigm and the display change after 5 ms was written for the needs of this experiment and kindly provided by SR Research support service. The position of the participants' left eye was used for tracking. Before the start of the experiment, a 3-point calibration was performed. During the experiment, a drift correction was performed before every sentence, using a single point displayed at the position of the first word of the sentence. This position was chosen to make sure that the participants would

not accidentally fixate on words in the center of the screen when the sentence was initially displayed after the drift correction, thereby prematurely unmasking the words. No additional fixation cross was presented after the presentation of the drift correction point. Drift corrections were performed more often than in the first eyetracking experiments to ensure a smooth presentation of the boundary paradigm. Most participants were aware of an unusual reading experience in the boundary paradigm, and some reported being aware of display changes as they moved their eyes, but being unable to read the masked versions of the words. Depending on the reading time measure, 4.7 % to 5.6 % of the data were removed as outliers.

4.2.2 Results

Means of reading time measures for Experiment 2.2 are given in Table 4.3 for unnormalised reading time measures and Table 4.4 for normalised reading time measures. Only statistically significant effects are reported, unless indicated otherwise. If the reported effects apply to both unnormalised and normalised data, the given statistical values are for normalised data. An overview of the results of all statistical calculations for Experiment 2.2 is given in the Appendix 2 in Table 4 on page 154 for unnormalised data and in Table 5 on page 155 for normalised data.

First pass times

Object NPs: There was a statistically significant main effect of object animacy on the object position ($F_1(1,51) = 18.68$, $p < .001$, $F_2(1,49) = 11.48$, $p < .01$). First pass times for animate object NPs were shorter than for inanimate object NPs.

Critical verbs: For unnormalised data only, there was a main effect of verb class. This main effect was statistically significant in the F_1 analysis, and marginally significant in the F_2 analysis ($F_1(1,51) = 7.52$, $p < .01$, $F_2(1,49) = 4.0$, $p < .06$). First pass times for the verbs were shorter in the accusative than in the dative

measure	condition	position			
		subject	object	adverb	cverb
First pass time	inanim acc	417 (15)	443 (23)	326 (11)	393 (12)
	anim acc	413 (15)	408 (17)	339 (11)	401 (14)
	inanim dat	410 (15)	452 (22)	337 (13)	413 (16)
	anim dat	411 (16)	409 (17)	337 (10)	416 (14)
Regression path duration	inanim acc	457 (18)	500 (30)	402 (23)	551 (45)
	anim acc	449 (20)	479 (28)	413 (28)	558 (47)
	inanim dat	459 (24)	521 (29)	401 (24)	564 (41)
	anim dat	451 (21)	474 (27)	398 (22)	548 (32)
Total reading time	inanim acc	701 (33)	733 (41)	515 (30)	544 (28)
	anim acc	735 (38)	748 (42)	562 (35)	564 (26)
	inanim dat	707 (39)	762 (43)	530 (29)	565 (27)
	anim dat	766 (39)	755 (43)	563 (29)	591 (26)

Table 4.3: Eye movement measures for Experiment 2.2, means over participants in ms (standard error of mean in parentheses)

measure	condition	position			
		subject	object	adverb	cverb
First pass time	inanim acc	9.1 (0.3)	9.4 (0.3)	7.0 (0.2)	8.6 (0.2)
	anim acc	8.7 (0.3)	8.6 (0.3)	7.2 (0.2)	8.6 (0.3)
	inanim dat	8.8 (0.2)	9.5 (0.3)	7.2 (0.2)	8.7 (0.2)
	anim dat	8.5 (0.2)	8.4 (0.3)	7.1 (0.2)	8.7 (0.3)
Regression path duration	inanim acc	9.8 (0.3)	10.4 (0.4)	8.4 (0.3)	11.1 (0.5)
	anim acc	9.2 (0.3)	9.8 (0.4)	8.6 (0.4)	11.1 (0.6)
	inanim dat	9.5 (0.3)	10.8 (0.4)	8.3 (0.3)	11.3 (0.5)
	anim dat	9.2 (0.3)	9.5 (0.4)	8.1 (0.3)	11.0 (0.4)
Total reading time	inanim acc	14.4 (0.3)	14.7 (0.4)	10.4 (0.3)	11.2 (0.2)
	anim acc	14.5 (0.3)	14.7 (0.4)	11.0 (0.3)	11.4 (0.2)
	inanim dat	14.0 (0.4)	15.1 (0.4)	10.6 (0.3)	11.4 (0.2)
	anim dat	14.7 (0.4)	14.3 (0.4)	10.8 (0.3)	11.7 (0.3)

Table 4.4: Normalised eye movement measures for Experiment 2.2, mean proportions over participants in percent (standard error of mean in parentheses)

conditions.

Regression path durations

Subject NPs: For normalised data only, there was a statistically significant main effect of object animacy ($F_1(1,51) = 9.67$, $p < .01$, $F_2(1,49) = 4.53$, $p < .05$). Normalised regression path times were longer in the animate than in the inanimate conditions. This effect was not statistically significant for unnormalised data.

Object NPs: There was a main effect of object animacy ($F_1(1,51) = 14.45$, $p < .001$, $F_2(1,49) = 8.71$, $p < .01$), with shorter regression path durations for animate object NPs than for inanimate object NPs.

Total reading times

Subject NPs: There was a main effect of object animacy that was statistically significant for unnormalised data ($F_1(1,51) = 9.70$, $p < .01$, $F_2(1,49) = 5.17$, $p < .05$) and marginally significant for normalised data ($F_1(1,51) = 3.13$, $p < .09$, $F_2(1,49) = 2.92$, $p < .1$). Total reading times for subject NPs were shorter in the inanimate than in the animate conditions.

Adverbs: There was a main effect of object animacy ($F_1(1,51) = 7.91$, $p < .01$, $F_2(1,49) = 5.45$, $p < .05$. Total reading times for adverbs were shorter in the inanimate than in the animate conditions.

Critical verbs: For unnormalised data only, there was a main effect of object animacy. This main effect of object animacy was statistically significant in the F_1 analysis, and marginally significant in the F_2 analysis $F_1(1,51) = 6.54$, $p < .05$, $F_2(1,49) = 3.84$, $p < .06$). Total reading times for verbs were shorter in the inanimate than animate conditions.

4.2.3 Discussion

Main effects of object animacy: The first pass times and regression path durations on animate object NPs were shorter than on inanimate object NPs. This fits the results of the first eyetracking experiment, measuring eye movements

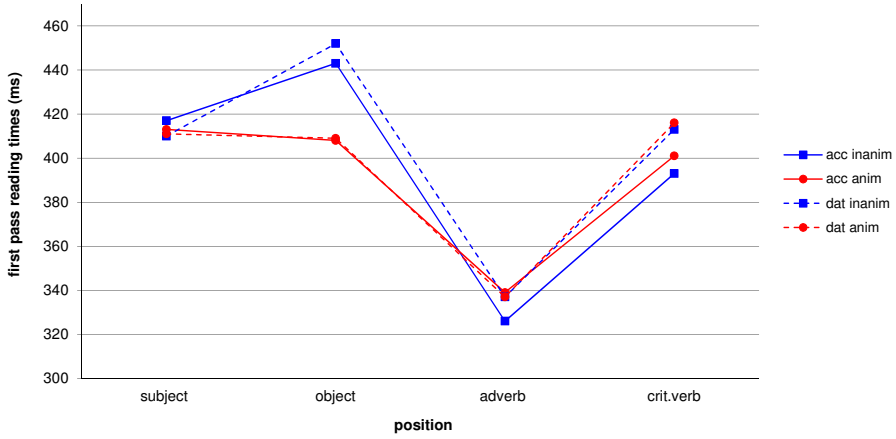

Figure 4.2: First pass times in Experiment 2.2 on single word positions in ms.

in natural reading. I interpret these early effects of object animacy as indicating that early processing steps are easier for animate than for inanimate NPs. While this facilitation only affected the first pass times of the object NPs in the natural reading experiment, the boundary experiment showed effects on the first pass times and regression path durations at this word position. This reflects how the denial of parafoveal information in the boundary paradigm changes reading behaviour and influences the time course of the effects found, probably pushing processing steps to later points in time than they would have occurred at during natural reading.

Total reading times on the subjects and adverbs were shorter in the inanimate than in the animate conditions. Total reading times on the verb were also shorter in the inanimate than in the animate conditions. However, this was only significant for unnormalised data. I interpret these later main effects of animacy as indicating higher processing costs for sentences with two animate arguments than with one animate and one inanimate argument. These results fit findings described in the literature (Frisch and Schlesewsky, 2001; Grewe et al., 2007; Trueswell et al., 1994; Weckerly and Kutas, 1999) and in the first eyetracking ex-

periment monitoring natural reading. The additional processing cost caused by two animate arguments affected the same reading time measures (total reading times on subjects and adverbs) in both experiments.

Main effects of verb class: For unnormalised data, first pass times on the critical verb were longer in the dative than in the accusative assigning condition. This effect did not reach significance for normalised data. I interpret this effect as reflecting higher processing costs for dative than for accusative assigning verbs. This is in line with the literature (Bader et al., 2000; Hopf et al., 1998) and with the first eyetracking experiment monitoring natural reading. Like in the first eyetracking experiment, verb class affects reading time measures as soon as the information about the verbal case marking pattern becomes available. For unnormalised data, total reading times on the critical verb were longer in the dative than in the accusative condition; however, this main effect was only statistically significant in the F_1 analysis.

Interaction effects of object animacy and verb class: There were no statistically significant interaction effects of object animacy and verb class in this second eyetracking study. The fact that there was no interaction on the adverb position in this second eyetracking study suggests that the interaction effect found in the first eyetracking study on the adverb position was not caused by some technical defect of the eyetracking equipment - when the verb was masked until the first direct fixation, the verb class information did not influence the first pass reading times of the adverb. (The difference between the two experiments concerning the interaction between object animacy and verb class is discussed further in the following section).

4.3 Comparison of both eyetracking studies

The results of both eyetracking experiments are in line with findings in the literature (Frisch and Schlesewsky, 2001; Grewe et al., 2007; Trueswell et al., 1994; Weckerly and Kutas, 1999), showing a strong influence of object animacy on

sentence comprehension. The main effects of object animacy visible in both experiments can be distinguished between late and early effects of object animacy. The early effects of object animacy are visible on first pass times (and, in the boundary experiment, regression path durations) of the object NPs, which are shorter for animate than for inanimate object NPs, indicating that word recognition is more costly for NPs with inanimate than with animate referents. This effect of animacy on the accessibility of single words is well known for picture and word naming (e.g., Janyan and Andonova, 2011). Findings from sentence production research show that animacy is one of the factors contributing to the conceptual accessibility of the referents of potential arguments. The conceptual accessibility of the referents in turn influences the assignment of grammatical roles (Bock and Warren, 1985; McDonald et al., 1993; Prat-Sala and Branigan, 2000, but see Chapter 6 for further details).

I interpret these early effects of object animacy as reflecting the influence of accessibility on the recognition of the single words before they are integrated into the unfolding sentence context.

The later effects of object animacy are visible on longer reading time measures (total reading times and regression path durations, depending on the presentation paradigm used) for subjects, adverbs and (and for some analyses, critical verbs) in the animate than in the inanimate conditions. These later effects of object animacy reflect the additional processing difficulty if two animate arguments without case marking information have to be integrated into the representation of a sentence. They are visible in both verb class conditions, suggesting that the use of animacy contrasts plays a very important role in sentence comprehension. The difference between the early and late effects of object animacy (shorter early measures, but longer later measures for the animate conditions) illustrates the difference between the reading of single words and the integration of these words into the unfolding sentence context.

The results of both eyetracking experiments are also in line with the literature concerning verb class effects. Dative-assigning verbs cause higher processing costs than accusative-assigning verbs, reflected in longer regression path durations and total reading times. This fits the results obtained by Bader et al. (2000).

The results of first eyetracking experiment monitoring natural reading (Experiment 2.1) supported my hypothesis, showing an interaction between object animacy and verb class on the first pass times of the adverb (which also affected total reading times in some analyses). In addition to supporting my hypothesis, the effect suggests that verb class information is already accessible during parafoveal preview and influences the fixation times of the word preceding the verb.

This parafoveal-on-foveal effect could be explained as a reflecting a combination of linguistic and prelinguistic processes. Earlier studies have shown that the familiarity of the letter combinations in the parafoveal field of vision (see, e.g., Lima and Inhoff, 1985) influences reading times and later eye movements. Many of the adverbs in the first eyetracking study were rather short, and the verbs are either short high-frequency verbs or begin with a preposition revealing the case marking pattern. Therefore, I assume that the first letters of the verbs can provide a high amount of information about the verb class already in the parafoveal field of vision. It could be argued that the eye movements after the first fixation of the adverb were controlled both by the processing of object animacy contrasts and by the likelihood of seeing certain letter combinations (that are an indication of verb class) with certain argument combinations. This would explain the interaction as an interaction between higher-order processes (like use of animacy contrasts in sentence comprehension) and early processes (influenced by familiarity or frequency of letter combinations)[1].

It is also possible to assume that the interaction reflects higher-order linguistic processing. Since this should be a possible cause for the interactions found in the other experiments, too, I will propose some candidates for these kinds of processes in the General Discussion in Chapter 6.

In the boundary experiment (Experiment 2.2), there was no interaction between the effects of verb class. This supports my interpretation of the interaction found in the first experiment as reflecting parafoveal processing. While the interaction might have been expected to occur at a later point in time (for example,

[1]This explanation would also suggest that sequences of two animate NPs are combined less often with accusative than with dative-assigning verbs, something that remains to be proven in a detailed corpus study. It would also imply that the interaction between object animacy and verb class also influences production.

on the first passt times or regression path durations of the verb), some of the effects of verb class visible in the first experiment were also not visible in this second experiment. Therefore, I assume that potential interactions could have been drowned in the overall longer reading times (known to occur in boundary paradigms, see, e.g., Rayner et al. 1982), and the general changes to reading behaviour caused by it. The difficulty in comparing between data gained from natural reading and reading in a boundary paradigm has been noted, among others, by Kennedy et al. (2004, p.151), who wrote "... if readers routinely take in information from more than one word at a time, the presence of masking might not simply deny access to certain information. The process of denial itself may influence the *way* in which the text is inspected.".

4.4 Conclusion

Both eyetracking studies show main effects of object animacy and verb class on eye movement measures during the comprehension of transitive sentences. These factors influence measures associated with word recognition as well as the integration of single words into the unfolding sentence context. They measurably affect reading behaviour even in the absence of grammatical or semantic violations. In natural reading, I found an interaction between object animacy and verb class. This supports my hypothesis that both kinds of information interact during the comprehension of transitive sentences.

I will discuss the linguistic processes possibly underlying this interaction effect in the General Discussion (Chapter 6).

Chapter 5

ERP study

Summary

In this chapter, I report the results of an ERP study. Like the preceding experiments, the ERP study showed an interaction between object animacy and verb class. This interaction was visible in the time window from 400 to 600 ms after the presentation of the verb in the left-posterior region of interest (ROI), showing a more positive-going waveform for the inanimate-accusative condition than for all three other conditions. In addition to the interaction, there were also numerous main effects of object animacy both on the verb and other word positions, and a small effect of verb class was visible on the first postverbal word. These findings again support the initial hypothesis, showing a modulation of the object animacy effect once verb class information becomes available.

5.1 Experiment 3: ERP study

The preceding experiments described in Chapter 3 and Chapter 4 showed an interaction between object animacy and verb class. The results of the eyetracking experiment monitoring eye movementes in natural reading suggest that object animacy and verb class interact during early processing steps. In the study presented in this Chapter, I used ERP measurements to investigate the timecourses of the influence of object animacy and verb class on sentence comprehension in more detail.

Participants 24 participants were recruited via the Humboldt University's experimental participant recruitment service (PESA). All participants were right handed, spoke German as their only native language and had no known reading or language-related problems. All participants gave written and informed consent. The data of four participants were excluded from the data analysis because of too many movement artifacts. The mean age of the remaining 20 participants was 25,3 years. Four of the 20 participants included in the study were male. Participants received 25 Euros recompensation.

Procedure The language material for the ERP study included 32 sentence quartets of the 50 original sentence quartets. The final list consisted of 192 sentences and contained 128 critical sentences (32 per condition) interspersed with 64 filler sentences. The 192 sentences were pseudorandomised in three different versions. 14 questions were asked after critical sentences and nine questions were asked after filler sentences. Half of the questions had the correct answer 'yes', the other half had the correct answer 'no'. Participants received feedback to the answers they gave.

The participants were seated in a comfortable chair in front of a computer screen, with a viewing distance of about 80 cm, in an acoustically and electrically shielded EEG recording chamber. They were instructed to rest their hands on two response button boxes. Half of the participants were assigned the left button for answering 'no' and the right for answering 'yes'. For the other half, the assignment was reversed.

The experiment consisted of an instruction phase and the experimental phase. Participants were first instructed orally and then again in written form on the screen during the instruction phase. The words of the instructions and of the stimulus sentences were presented visually in the center of a computer screen, using the Presentation software by Neurobehavioral Systems Inc.. Before the first word of each sentence, a blank screen was presented for 1200 ms, followed by an asterisk presented in the center of the screen for 500 ms. The first two and last three words of the matrix sentence were presented together, while the remaining words were presented in a word-by-word fashion. This means that the embedded sentence and the first two postverbal words (*und* and a personal name) were presented as single words:

Tim glaubt,— dass — Tauben — Luftballons — gerne — mögen, — und — Tom — glaubt das auch.

Each word or string of words was presented for 700 ms, followed by a 100 ms blank screen. Participants pressed one of the response buttons to change to the next screen during the instruction phase and to start the presentation of the next sentence during the experiment. They answered the questions by pressing the left or right response button, respectively. Half of the participants pressed the right and the other half the left response button to answer 'yes'. Feedback on the answers to the questions was presented for 1500 ms. About every 30 sentences, participants were offered to take a short break, resulting in 6 breaks during the course of the experiment. Before the actual experiment, participants saw three practice trials. The experimental phase lasted about 45 minutes.

The EEG was recorded with 32 Ag/AgCl sintered ring electrodes attached to an elastic cap (EasyCap, Gilching) and connected to an Easy-Cap Electrode Input Box EiB32. Electrodes were placed in the following positions according to the 10-20 system: C3, C4, CP5, CP6, CPz, Cz, F3, F4, F7, F8, FC5, FC6, FCz, Fz, O1, O2, Oz, P3, P4, P7, P8, POz, Pz. The EEG signal was amplified with a BrainAmp DC amplifier (Brain Products, Gilching) connected to a personal computer outside of the EEG chamber via a USB2 Adapter (Brain Products, Gilching). The signal was recorded with a digitisation rate of 250 Hz. Eye move-

ments were monitored by recording the electrooculogram. Horizontal movements were recorded from the left and right outer canthi, and vertical movements were recorded above and below the right eye. Electrodes were referenced to linked mastoids. Electrode impedances were kept below 5 kΩ.

Data were processed using the Brain Vision Analyzer software (Brain Products Gilching). Before segmentation, the raw data were filtered with two Butterworth Zero Phase Filters, one 0.5 Hz low-cutoff / high-pass filter and one 70 Hz high-cutoff/low-pass filter, and a 50 Hz Notch filter. The filtered data were segmented into time windows from 100 ms before to 900 ms after onset of the critical words (i.e., onset of the subject, object, adverb, verb, and of the postverbal *und*), resulting in different segments timelocked to the indicated word positions in the sentence. After segmentation, a baseline correction was performed for 100 ms before stimulus onset. Trials including artifacts or blinks were rejected semi-automatically from the segmented data. Artifacts were defined according to the following parameters: The maximal allowed voltage step per sampling point was 50 µV. The maximal allowed absolute difference of two values in a segment was 300 µV. The minimal allowed amplitude was -200 µV, the maximal allowed amplitude was 200 µV. The lowest allowed activity (max - min) was 0.5 µV in an interval of 100.00 ms. Condition averages were calculated for each participant. Participants with averages containing less than 20 segments in one or several of the conditions were excluded from the statistical data analysis and Grand Averages, leaving 20 participants of the original 24. Grand Averages were smoothed with an additional 10 Hz low-pass filter for data presentation.

Data analysis Based on previous studies and on visual inspection of the single electrodes, I defined the following regions of interest (ROIs): left frontal (F3, F7, FC5), right frontal (F4, F8, FC6), left posterior (P3, P7, CP5), right posterior (P4, P8, CP6) and midline (Fz, FCz, Cz, CPz, Pz). The mean voltages for the single ROIs were calculated from the condition averages of all participants. The analysed time windows were chosen based on visual inspection of the data and comparisons with previous studies, which suggest an influence of both object animacy and case marking during the N400 time window. For each chosen time window, I performed a repeated measures ANOVA of the mean voltages in all

five ROIs, with object animacy and verb class as within-subject factors.

5.2 Results

The results of the ERP study are described for the ERPs timelocked to the indicated word positions in the sentence. I only report statistically significant effects unless stated otherwise.

Object: Grand average ERPs timelocked to the object are shown in Figure 5.1 on page 74 for single electrodes and in Figure 5.2 on page 75 for selected ROIs. In the time window from 400 to 600 ms, there was a main effect of object animacy in the right-posterior and right-anterior ROIs (right posterior: $F(1,19) = 6.91$, $p < .05$, right-anterior: $F(1,19) = 9.20$, $p < .01$). Waveforms were more negative-going for animate than for inanimate objects at midline, right-anterior and right-posterior sites, starting shortly after 400 ms.

Adverb: Grand average ERPs timelocked to the adverb are shown in Figure 5.3 on page 76 for single electrodes and in Figure 5.4 on page 77 for selected ROIs. There was a significant main effect of object animacy on the left-posterior ROI $F(1,19) = 6.53$, $p < .05$ and the right-posterior ROI $F(1,19) = 4.58$, $p < .05$. Waveforms for the adverbs were slightly more negative-going in the animate than in the inanimate conditions between 300 and 500 ms in both left and right posterior sites.

Verb: Grand average ERPs timelocked to the verb for single electrodes are shown for accusative conditions in Figure 5.5 on page 79 and for dative conditions in Figure 5.6 on page 80. Grand average ERPs for selected ROIs are shown in Figure 5.7 on page 81.

right-posterior ROI: In the time window from 400 to 600 ms, there was a significant main effect of object animacy ($F(1,19) = 13.68$, $p < .01$). Waveforms were slightly more negative-going for animate than for inanimate conditions for both verb classes.

left-posterior ROI: In the time window from 400 to 600 ms, there was a significant main effect of object animacy ($F(1,19) = 5.32$, $p < .05$) and a marginally

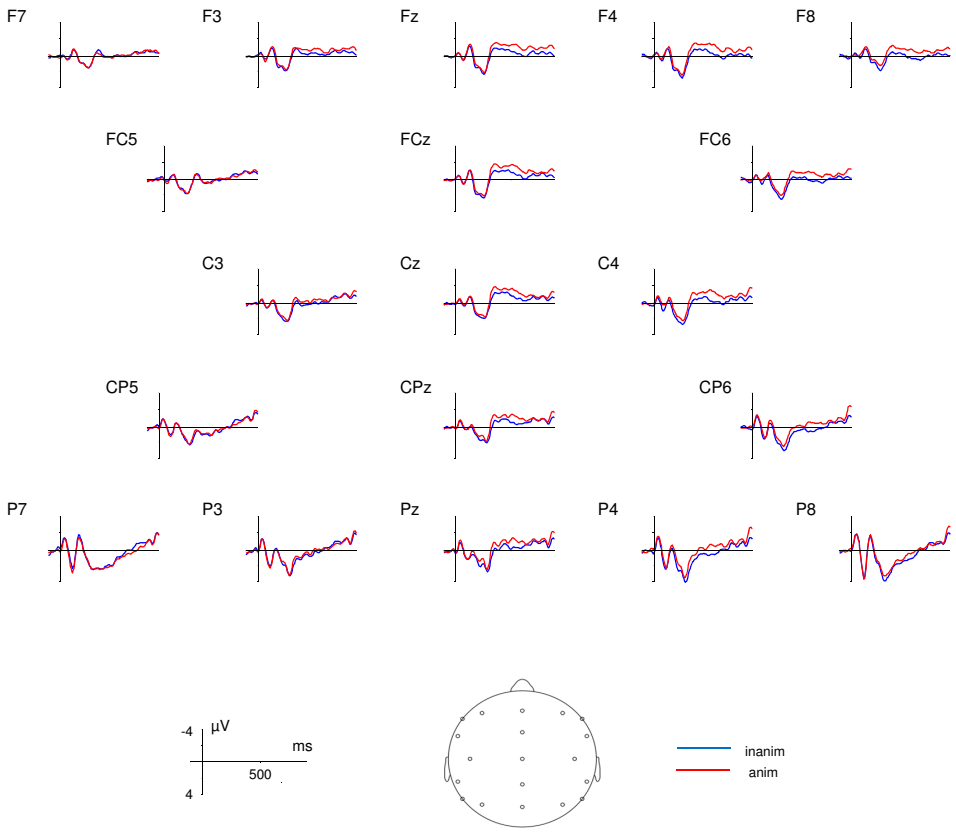

Figure 5.1: Experiment 3: Grand average ERPs at selected electrodes time-locked to the object NPs, showing mean voltages for inanimate vs animate conditions. Negativity is plotted upwards.

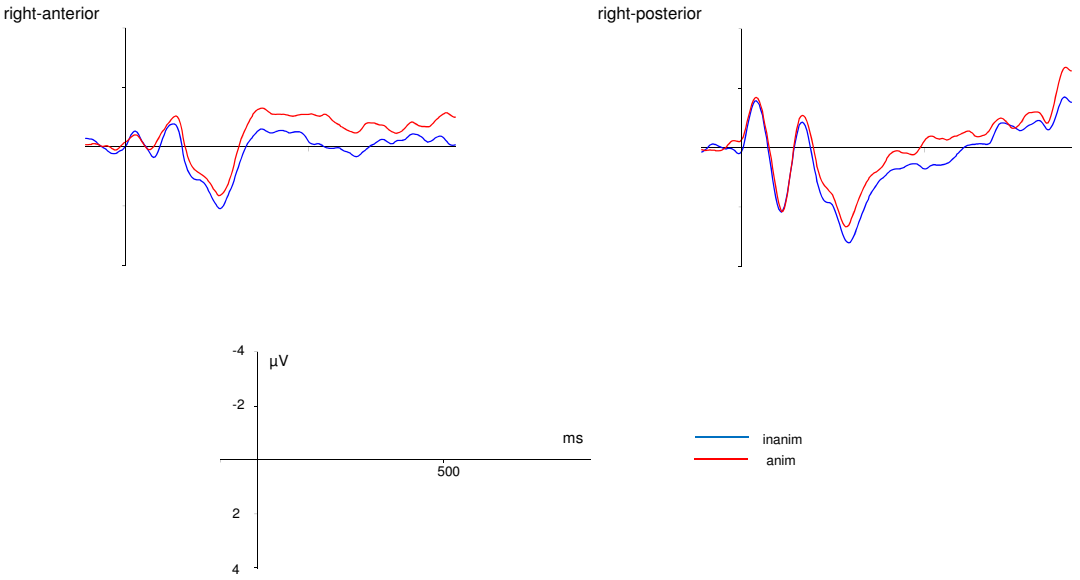

Figure 5.2: Experiment 3: Grand average ERPs at selected ROIs time-locked to the object NPs, showing mean voltages for inanimate vs animate conditions. Negativity is plotted upwards.

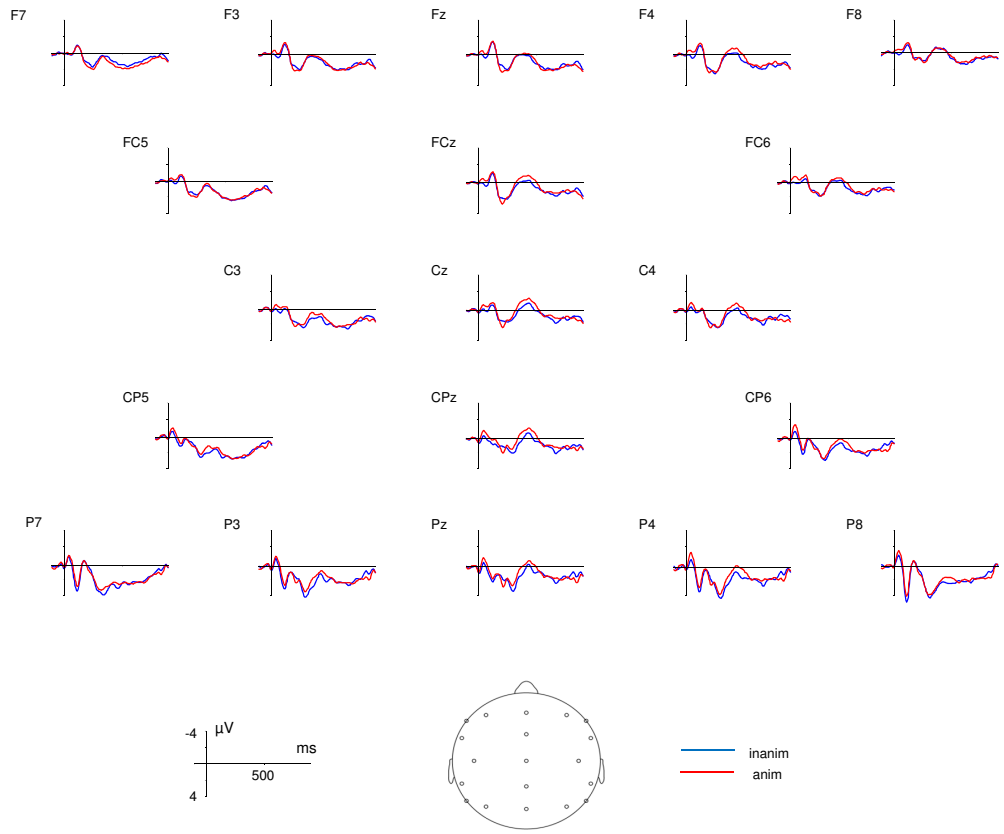

Figure 5.3: Experiment 3: Grand average ERPs at selected electrodes time-locked to the adverb, showing mean voltages for inanimate vs animate conditions. Negativity is plotted upwards.

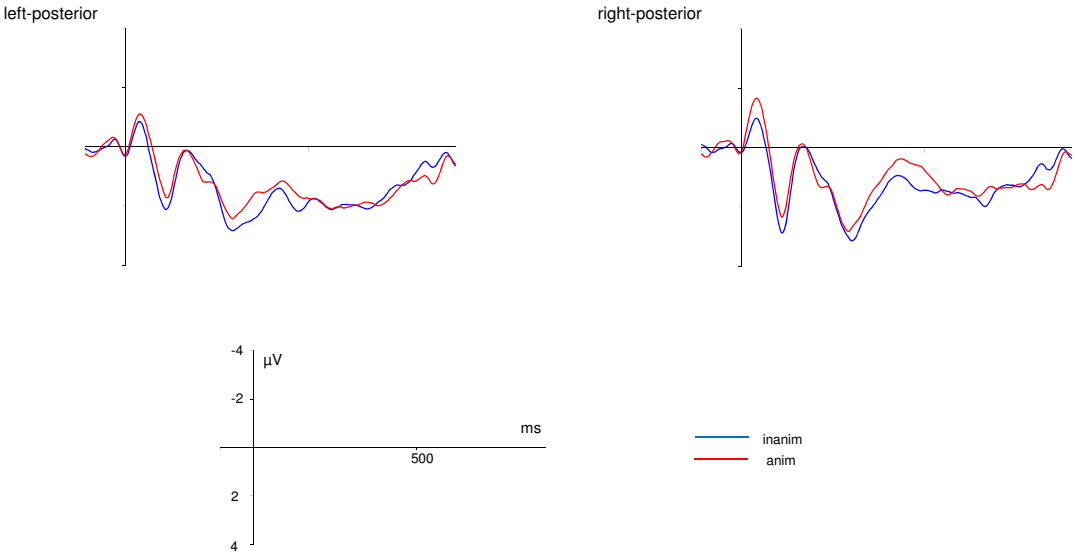

Figure 5.4: Experiment 3: Grand average ERPs at selected ROIs time-locked to the adverb, showing mean voltages for inanimate vs animate conditions. Negativity is plotted upwards.

significant interaction between object animacy and verb class ($F(1,19) = 4.30$, $p < .06$). The simple main effect of object animacy was significant in the accusative condition ($F(1,19) = 11.13$, $p < .01$), but not in the dative condition ($F(1,19) = .003$, $p > .90$). In the accusative condition, waveforms for the animate condition showed a broad negative shift relative to the inanimate condition, starting at around 200 ms and continuing until the end of the segment. In the dative condition, waveforms for inanimate-dative and animate-dative conditions remained closely together.

postverbal *und*: Grand average ERPs timelocked to the first postverbal word *und* for single electrodes are shown for inanimate conditions in Figure 5.8 on page 82 and for animate conditions in Figure 5.9 on page 83. Grand average ERPs for selected ROIs are shown in Figure 5.10 on page 84. In the time window from 200 to 400 ms, there was a significant main effects of verb class in the time window from 200 to 400 ms in the midline ($F(1,19) = 8.28$, $p < .01$), left-anterior ($F(1,19) = 10.52$, $p < .01$) and left-posterior ($F(1,19) = 9.96$, $p < .01$) ROIs. Starting at around 200 ms, waveforms were slightly more positive-going in the dative than in the accusative condition.

5.3 Discussion

Main effects of object animacy: There were significant main effects of object animacy on the object NPs, adverbs and verbs. The general pattern of the object animacy effects was that the waveforms were shifted to more negative values in the animate compared to the inanimate condition, starting at around 300 to 400 ms after the presentation of the word in question. (There was one exception to this pattern, see the paragraph below on interactions.) The effect was most clearly visible on the right hemisphere after the presentation of the object, for posterior ROIs in both hemispheres after the presentation of the adverb, and for the right-posterior ROI after the presentation of the verb. I interpret this negative shift as representing the additional processing cost caused by two animate arguments without morphological case marking. The additional processing cost started once

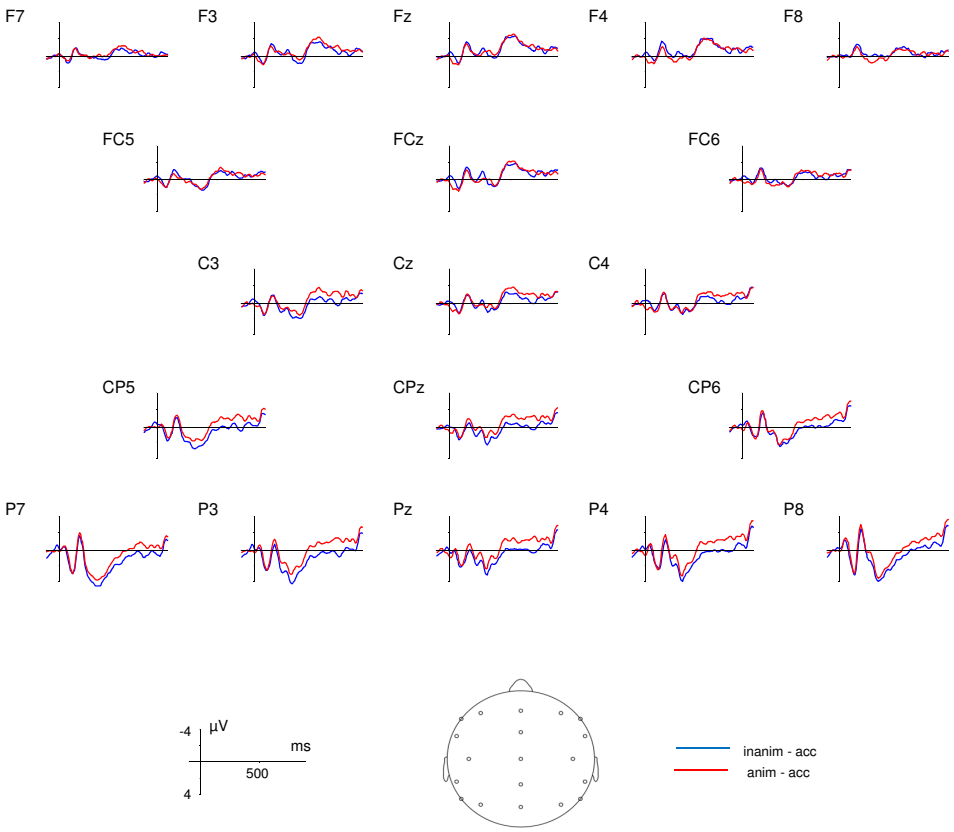

Figure 5.5: Experiment 3: Grand average ERPs at selected electrodes time-locked to the verb for the accusative conditions, showing mean voltages for inanimate-accusative vs animate-accusative conditions. Negativity is plotted upwards.

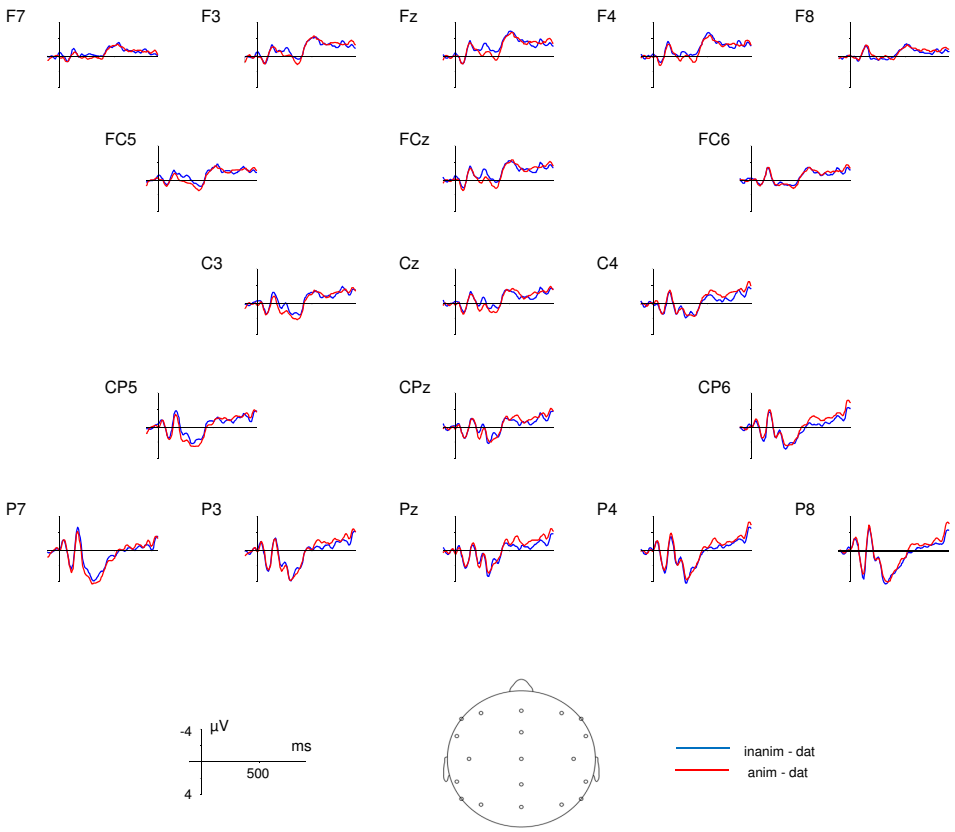

Figure 5.6: Experiment 3: Grand average ERPs at selected electrodes time-locked to the verb for the dative conditions, showing mean voltages for inanimate-dative vs animate-dative conditions. Negativity is plotted upwards.

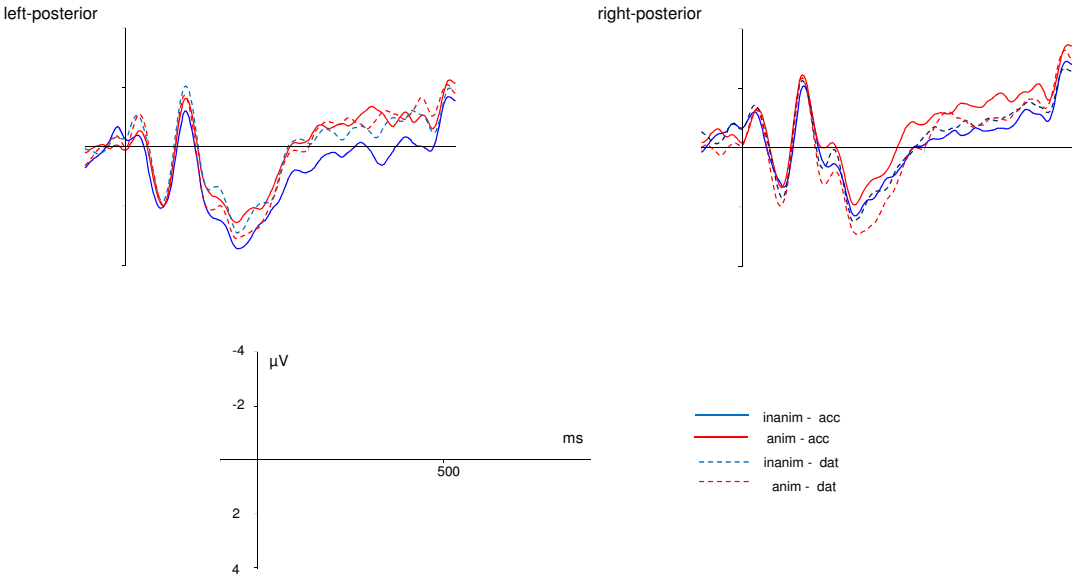

Figure 5.7: Experiment 3: Grand average ERPs at selected ROIs time-locked to the verb, showing mean voltages for all four conditions. Negativity is plotted upwards.

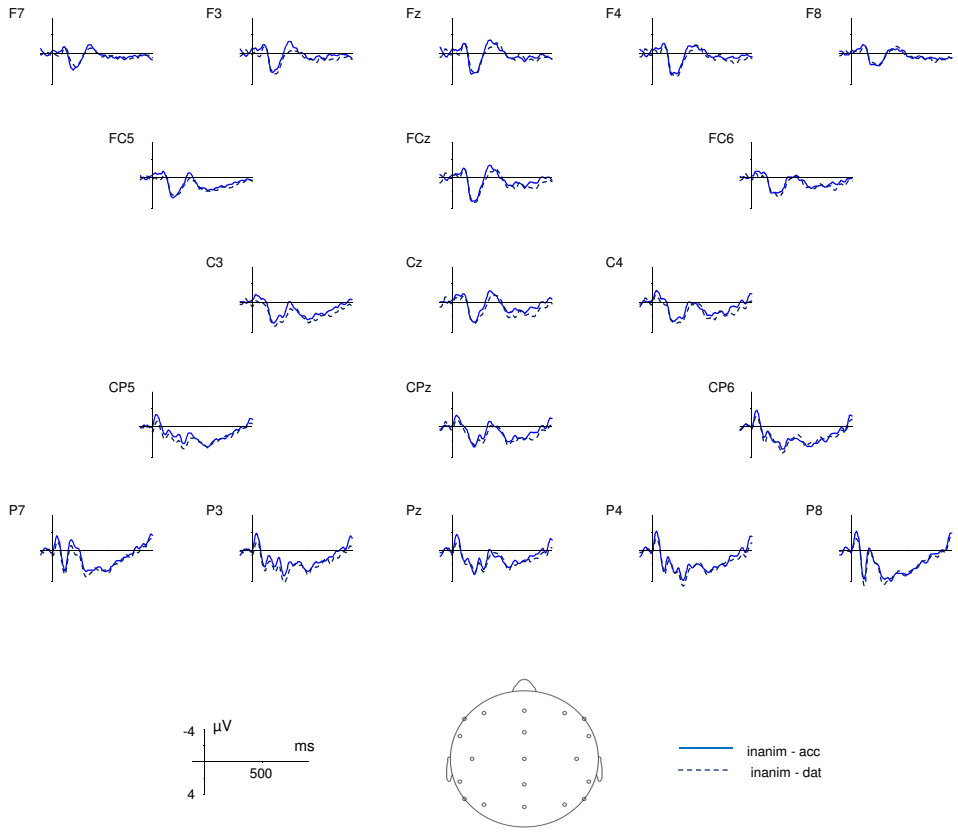

Figure 5.8: Experiment 3: Grand average ERPs at selected electrodes time-locked to the postverbal *und*, showing mean voltages for both inanimate conditions. Negativity is plotted upwards.

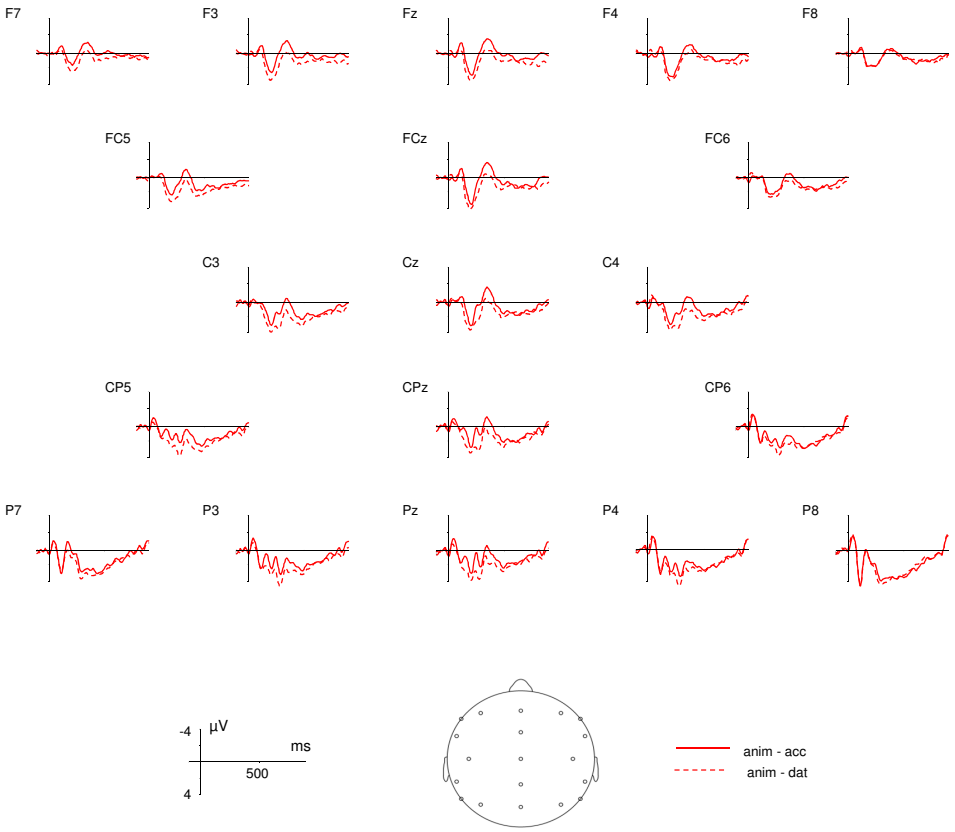

Figure 5.9: Experiment 3: Grand average ERPs at selected electrodes time-locked to the postverbal *und*, showing mean voltages for both animate conditions. Negativity is plotted upwards.

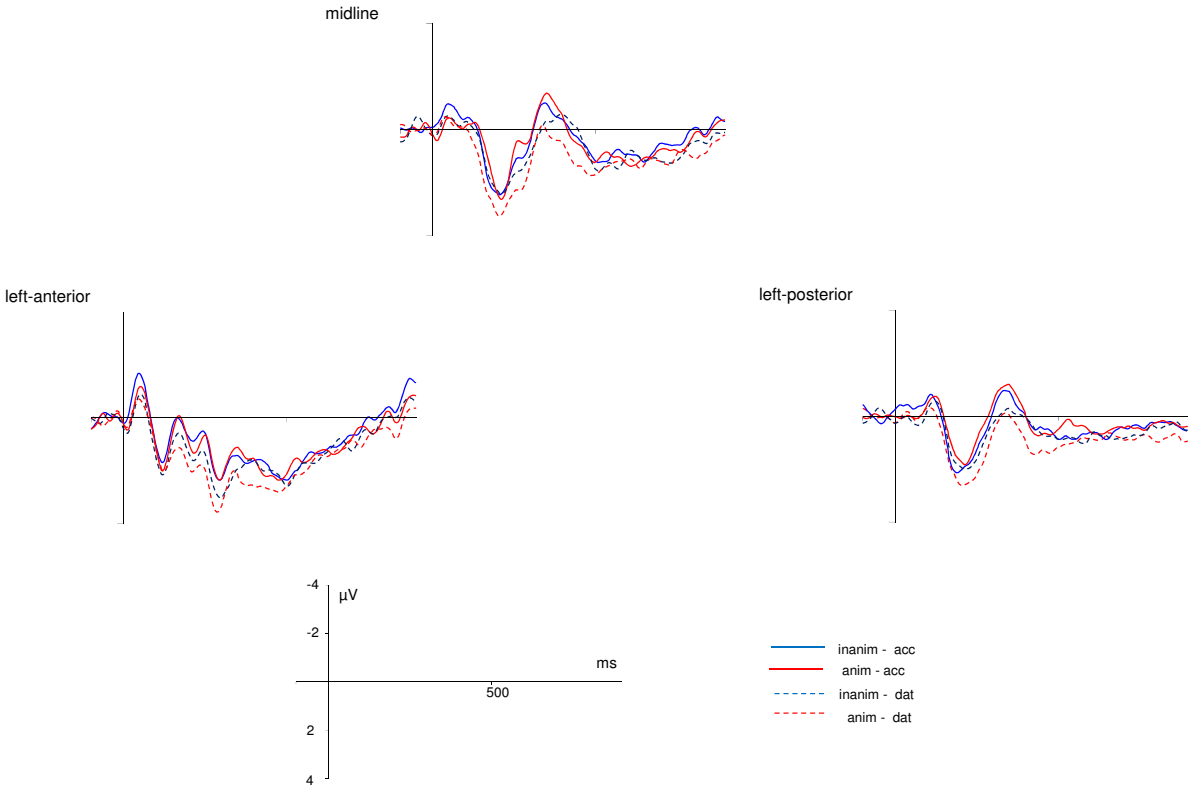

Figure 5.10: Experiment 3: Grand average ERPs at selected ROIs time-locked to the postverbal *und*, showing mean voltages for all four conditions. Negativity is plotted upwards.

the animate object NPs were presented, and continued to influence the event-related potentials to the subsequent two words.

The main effects of object animacy in this study are comparable to the literature. Frisch and Schlesewsky (2001) reported N400-like negativities for sentences with animate objects compared to sentences with inanimate objects in the absence of disambiguating case marking. The authors interpret this N400 as a reflection of problems in thematic hierachising, i.e., in assigning thematic roles like 'agent' and 'patient' to the arguments.

Difficulties in thematic hierachising are processed differently from violations of a verb's selectional restrictions concerning argument animacy. In the literature on semantic illusions (e.g., Hoeks et al. 2004; Kim and Osterhout 2005; Kuperberg et al. 2007, 2003, 2006), it has often been reported that the violation of animacy restrictions does not necessarily lead to an enhanced N400. For example, Kuperberg et al. (2007) report an enhanced P600 on the verbs of English transitive sentences with inanimate *subjects*. Unlike our stimuli or the stimuli used by Frisch et al., Kuperberg et al.'s stimulus sentences contained subjects that clearly violated the verb's selectional restrictions for subject animacy. Compared to a baseline condition (baseline condition: *For breakfast the boys would eat toast and jam*), they report enhanced P600s both for subjects that were semantically related (as in *For breakfast the eggs would eat toast and jam*) or unrelated (*For breakfast the eggs would plant flowers in the garden*) to the verbs. The authors suggest that there is no N400 for these violations of selectional restrictions because the process underlying the N400 (i.e., semantic integration) is possibly attenuated because of another process reflected by the P600 (namely, the processing of thematic role violations, see Kuperberg et al. 2007, pages 234-235). However, they find an N400 compared to the baseline condition on the verbs of sentences where the sentence context violates the pragmatic expectations of the verb in question (*For breakfast the boys would plant flowers in the garden*).

In my ERP experiment, the negative shift that is caused by animate objects on the waveforms of objects, adverbs and on the verbs looks different from the classical N400 (Kutas and Hillyard, 1982). Unlike a classical N400 caused by a semantic violation, most of the waveforms do not show a peak with a clear beginning and end, but rather a broad negative shift in the waveform. Depending

on the word position, the distribution of the negative shift does also not match the classical distribution of the N400, which is visible at right-to-centroposterior sites. Nevertheless, I assume that the negative shift reported as a main effect of object animacy reflects additional processing costs that are caused by one of the factors that cause proper N400s in true violation scenarios. I believe that the negative deflections in the waveform indicate additional workload because of the processing of semantic or thematic information. The fact that two animate objects do not cause P600 modulations fits in well with findings from the literature, given that the stimulus material used in my ERP study does not contain violations of either phrase structure or selectional restrictions.

Main effects of verb class: The only main effects of verb class in the ERP study were visible on the first postverbal word *und*. Especially on the left and midline sites, the waveforms were slightly more positive-going in the dative than in the accusative condition, starting at around 200 ms. This effect was not modulated by object animacy. I interpret this main effect of verb class as a reflection of the additional processing cost caused by the processing of dative-assigning verbs compared to accusative-assigning verbs.

At a first glance, this main effect of verb class does not fit the findings in the literature. Hopf et al. (1998) investigated the processing of dative-assigning compared to accusative-assigning verbs. They report a broad negative shift for dative compared to accusative verbs, on centroposterior sites, starting around 300 ms after the presentation of the critical verbs. They assume that this negativity reflects the additional processing costs caused by the assignment of a lexical dative instead of structural accusative case to the direct object NPs. They suggest that upon encountering the dative-assigning verb, the parser has to reaccess the lexical entry of the object NP to check whether dative case is morphologically licensed, and suggest that the processing difficulty is lexical rather than syntactic. The stimulus material used by Hopf et al. (1998) consists of transitive sentences with two animate arguments, and does not include sentences with inanimate arguments. The results of my ERP study show a positive deflection for dative-assigning verbs on the first postverbal word only. On the critical verb (described in more detail in the paragraph on interactions, below), waveforms

for dative-assigning verbs are more negative than for accusative-assigning verbs. However, my own results show no difference between the animate-accusative and the animate-dative conditions. This is different from the results reported by Hopf et al. (1998). Therefore, I assume that the stimulus material used by Hopf et al. (1998) and by myself apparently differs in too many ways for direct comparison.

Bornkessel et al. (2004) also investigate differences in the processing of dative- compared to accusative-assigning verbs. However, they do not compare directly between their dative- and accusative-assigning conditions, argueing that the conditions differ in too many ways to allow a statistical analysis. They do however show the waveforms comparing dative- to accusative-assigning verbs across all conditions including fillers, showing that dative-assigning verbs show more positive waveforms than accusative-assigning verbs (Bornkessel et al., 2004, 504, Fig.4). A closer analysis of their effects revealed that argument order manipulations elicit P600 effects for accusative-assigning verbs, while they elicit enhanced N400 components for dative assigning verbs. The authors argue that word order manipulations cause a revision of phrase structure with accusative-assigning verbs, while dative-assigning verbs make access to object-initial word orders easier, irrespective of the specific verb's preferred word order (subject-first or object-first). In the second experiment reported in Bornkessel et al. (2004), they compared between the effect of different word orders (NOM-DAT vs DAT-NOM) for different classes of dative-assigning verbs (active dative verbs (like *folgen*, "to follow") and object-experiencer dative verbs (like *gefallen*, "to please"). Their findings indicate that word order and verb class interact in the 350 to 550 ms time window on left-hemispheral ROIs, while main effects of word order were visible in central-posterior and right-posterior ROIs. The authors argue that the P600 reflects the reanalysis of phrase structure, while the N400 found in their experiments reflects the revision of case marking.

The statistically significant main effect of verb class visible in my ERP study only causes a small deflection in the ERP, and is only visible at this first postverbal position, which is a very short function word that was the same for all sentences. For future studies, it would be interesting to see whether the main effect of verb class on sentence comprehension is indeed quite short-lived, or whether a longer controlled postverbal region might allow monitoring the main effect of verb class

at later word positions in the sentence. I will continue with the discussion of the influence of verb class on sentence comprehension during the discussion of the interaction between object animacy and verb class in the next paragraph.

Interactions between object animacy and verb class: There was a statistically significant interaction between object animacy and verb class in the time window from 400 to 600 ms in the left-posterior ROI. The effect of object animacy in this ROI was modulated by verb class: In the animate-accusative condition, the waveforms showed a broad negative shift starting at around 200 ms compared to the inanimate-accusative condition. The waveforms for the animate-dative and inanimate-dative condition, on the other hand, ran parallel to the one for the animate-accusative condition. There was no difference between the inanimate-dative and the animate-dative condition in this ROI.

The presence of an interaction between object animacy and verb class supports my initial hypothesis: The additional processing cost caused by object animacy is modulated by verb class, resulting in different ERPs for accusative-assigning compared to active dative-assigning verbs. I assume that the negative deflection found in the animate-accusative condition compared to the inanimate-accusative condition reflects the thematic processing difficulty, comparable to the negative deflections found for the animate conditions on earlier word positions. This is in line with Frisch and Schlesewsky (2001), who reported an N400 for sentences with two animate arguments in the absence of case marking. As mentioned above, object animacy does not cause a sharp peak resembling a traditional N400 on the verb. Nevertheless, I assume that the negativity reported here reflects additional processing costs comparable to the ones reported by Frisch and Schlesewsky (2001), and that the difference to a classical N400 can be accounted for by the fact that my stimulus material is neither ungrammatical nor implausible.

The waveforms to the inanimate-dative and animate-dative conditions are both more negative-going than the inanimate-accusative baseline condition. In line with Bornkessel et al. (2004), I assume that this broad negative deflection reflects additional processing costs caused by a revison of case marking, which is necessary for both the animate and the inanimate objects once the case marking

pattern of the verb has become available. Therefore, I assume that different processes cause the negative deflection compared to the baseline in the animate-accusative and the dative conditions.

This interpretation does not explain the role of object animacy in the dative conditions. It is possible that the processes using argument animacy contrasts continue running in parallel to the processes that reassign case, but that their potential reflection in the ERP is masked by the processes reassigning case. It is also possible that dative-assigning verbs do not only enable access to different word orders (as assumed by Bornkessel et al., 2004), but also license argument animacy patterns that diverge from the animate subject - inanimate object sequence preferred by accusative verbs. This interpretation is especially attractive in the context of heuristic sentence processing (Christianson et al., 2001; Ferreira, 2003; Ferreira et al., 2002; Ferreira and Patson, 2007).

5.4 Conclusion

The results of the ERP experiment support my initial hypothesis, showing a statistically significant interaction of object animacy and verb class after the presentation of the critical verb on left-posterior sites in the time window from 400 to 600 ms.

Apart from this interaction, there was a small main effect of verb class on the first postverbal word, and a number of main effects of object animacy, starting after the presentation of the animate objects, and extending up to one or two words after the object NP, depending on verb class and ROI. Like in the self-paced reading times and eyetracking experiments presented in this dissertation, argument animacy information has an immediate and longlasting effect on sentence comprehension. This effect of object animacy is modulated by verb class, with the interaction between the different kinds of information starting as soon as the noncanonical case marking pattern of the verbs become available.

Chapter 6

General Discussion and Conclusion

In this dissertation, I tested the hypothesis that the influence of object animacy on the comprehension of transitive sentences is modulated by verb class. This hypothesis led to the prediction that the additional processing difficulty found for animate compared to inanimate objects would be different for sentences with dative-assigning verbs compared to sentences with accusative-assigning verbs.
To test this hypothesis, I performed a series of experiments, using self-paced reading time measurements, eyetracking and ERP measurements.

6.1 Summary of the findings

The language material for all experiments was based on a set of 50 sentence quartets. Critical sentences were embedded transitive sentences, consisting of subject-object-adverb-verb sequences. The referents of the objects were either inanimate or animate, and the verbs assigned either nominative-accusative or nominative-dative to their arguments. The language material is described in detail in Chapter 2. For greater convenience, a representative sentence quartet is repeated in Example 6.1.

Example 2 Example of a typical sentence quartet. Note that case morphology is not marked overtly on the arguments.

(A) inanimate object, accusative-assigning verb:

Tim glaubt, dass Tauben Luftballons gerne mögen, und Tom
Tim believes that dove.PL.(NOM) airballoon.PL.(ACC) gladly like.3PL and Tom
glaubt das auch.
believes that too

Tim believes that doves rather like balloons, and Tom believes that, too.

(B) animate object, accusative-assigning verb:

Tim glaubt, dass Tauben Krähen gerne mögen, und ...
Tim believes that dove.PL.(NOM) crow.PL.(ACC) adv like.3PL and ...

Tim believes that doves rather like crows, and ...

(C) inanimate object, dative-assigning verb:

Tim glaubt, dass Tauben Luftballons gerne folgen, und ...
Tim believes that dove.PL.(NOM) airballoon.PL.(DAT) adv follow.3PL and ...

Tim believes that doves like following balloons, and ...

(D) animate object, dative-assigning verb:

Tim glaubt, dass Tauben Krähen gerne folgen, und ...
Tim believes that dove.PL.(NOM) crow.PL.(DAT) adv follow.3PL and ...

Tim believes that doves like following crows, and ...

The self-paced reading time study (described in Chapter 3) showed longer reading times in the animate compared to the inanimate conditions at the positions of the adverb and the critical verb. This main effect of object animacy was modulated by verb class information once the verb had been read: On the first postverbal *und*, there was an interaction of object animacy and verb class. Reading times were longer in the animate-accusative than in the inanimate-accusative condition, but there was no difference between the two dative conditions.

The two eyetracking studies are described in Chapter 4. The first eyetracking study tested sentence comprehension in natural reading. The results showed main effects of object animacy and verb class for different reading time measures at different positions in the sentence. In general, reading time measures were longer for animate than for inanimate conditions, and longer for dative than for accusative conditions. One exception was the first-pass reading time of the object, which was faster in the animate than in the inanimate conditions. There was also a critical interaction of object animacy and verb class, visible during the first-pass times of the adverb. First-pass times for the adverb were longer in the animate-accusative than in the inanimate-accusative condition, while there was no difference in first-pass times for the adverb on both dative conditions. The presence of an interaction on this word position can be explained as reflecting parafoveal processing of verb class information.

The second eyetracking study used a boundary paradigm to exclude the possibility of parafoveal processing. In this study, the general pattern of main effects was comparable to the first eyetracking study, but there were no statistically significant interactions between object animacy and verb class.

The ERP study (described in Chapter 5) showed main effects of object animacy after the presentation of the object, adverb and verb, and a small main effect of verb class on the postverbal *und*. The main effects of object animacy were visible as more negative-going waveforms in the animate than in the inanimate conditions during the N400 time window. After the presentation of the verb, this main effect of object animacy was modulated by the verbal case marking pattern. This modulation was visible as an interaction between object animacy and verb class in the left-posterior ROI, with more negative-going waveforms in the animate-accusative than in the inanimate-accusative condition. There was no

main effect of object animacy for both dative conditions during this time window on the left-posterior ROI.

The results obtained with all three experimental methods support my initial hypothesis, showing an interaction between object animacy and verb class. These interactions are visible in addition to robust main effects of object animacy and, for eyetracking and ERP, some main effects of verb class. Main effects of object animacy and verb class were expected given previous findings in the literature, and served as control effects.

In the following, I will discuss differences in the time course of the main effects and interactions found with the different experimental methods. I will continue with the discussion of different possible linguistic processes that might be reflected in the critical interaction.

6.2 Timecourses of effects, depending on the method chosen

All experimental methods showed consistent main effects of object animacy. Most of them indicated increased processing costs for animate compared to inanimate objects. This indicates that the use of animacy contrasts is a robust and important strategy in the comprehension of transitive sentences, a fact that is also reflected in the models mentioned in the Introduction.

Interestingly, in both eyetracking experiments, the first pass times for animate objects were shorter than for inanimate objects. This suggests that early processing steps of NPs with animate referents are actually faster than those of NPs with inanimate referents, although they are more difficult to integrate into the sentence context later on. The different effects of object animacy in the eyetracking experiments illustrate how sentence processing proceeds from word recognition to the integration of the words into the sentence context. The initial advantage found for animate compared to inanimate objects suggests parallels between sentence comprehension and production: Research in sentence production has shown that animate referents are conceptually more accessible and are processed first. Therefore, they are more likely to be used as the grammatical

subject of a sentence (Bock and Warren, 1985; McDonald et al., 1993; van Nice and Dietrich, 2003). It is possible that nouns denoting animate referents are generally retrieved faster from the mental lexicon than nouns denoting inanimate referents, reflected in the shorter first pass reading times.

The main effects of verb class were most clearly visible in the eyetracking experiments, especially in the natural reading paradigm. Verb class affected the regression path times and the total reading times of the critical verb in natural reading, lengthening the relevant measures for dative compared to accusative-assigning verbs. These measures are associated with later processing steps. In addition, the first pass times of the adverb showed a significant main effect of verb class (together with the critical interaction of object animacy and verb class), with shorter first-pass times in the dative than in the accusative condition. In the ERP experiment, the only main effect of verb class is visible as a spillover effect on the postverbal *und*. The first influence of verb class was visible in the interactions between object animacy and verb class. The general pattern of the findings suggests that verb class information is accessed very fast in comprehension (visible in the main effect of verb class on the adverb in natural reading, in the interaction between object animacy and verb class at the same position in natural reading, and on the verb in the ERP study) and has a long-lasting effect (visible in the later reading time measures in natural reading, and in the spillover effect on the postverbal *und* in the ERP experiment).

Both object animacy and verb class influenced eyetracking and ERP measures as soon as they became available, and continued influencing the measures of the following words. Therefore, I assume that both kinds of information influence early processing steps (like single word recognition) and later processing steps (like integration of the words into the sentence context) during sentence comprehension.

Three of the four experiments performed for this dissertation yielded statistically significant interactions between object animacy and verb class. The time course of these effects, however, was different for different experimental methods.

The earliest interaction was found in the natural reading paradigm. Verb class and object animacy interacted already during the first pass reading times of the

preverbal adverb. This early interaction effect suggests that verb class information is already accessed during parafoveal preview of the verb while the eyes are still fixating the adverb position. This suggests that verbal case marking patterns are accessed early when the word is recognised, and that this early processing step can already happen during parafoveal preview of the verb. Verb class therefore influences the incremental comprehension of a transitive sentence as soon as this information becomes available. The fact that neither the interaction between object animacy and verb class nor the main effects of verb class were visible with the boundary paradigm shows that the effect indeed reflects parafoveal processing. It also illustrates how strongly the choice of the presentation paradigm influences the measures of comprehension processes in eyetracking.

In the ERP study, the sentences were presented one word at a time, at a speed chosen by the experimenter. Again, the interaction was visible once verb class information became available - in this experiment, this was on the position of the critical verb. The word-by-word presentation paradigm made this the earliest possible time for access to lexical information about the verb, and the interaction between verb class and object animacy was visible from about 400 ms on. The time window for the interaction was 400 to 600 ms after the presentation of the verb. This corresponds to the N400 time window that has been associated with a reassignment of case, among other factors, and where interactions between the word order of the sentence and the unmarked word order of different classes of dative verbs have been reported (Bornkessel et al., 2004).

Self-paced reading times only showed significant interactions between object animacy and verb class on the directly postverbal *und*. Just like the ERP experiment, the self-paced reading time stimuli were presented one word at a time. However, here the participants chose their own presentation speed. Self-paced reading time effects tend to occur later than more direct measures like gaze direction or ERPs. The main effects of object animacy only reached full statistical significance on the adverb, and unlike the other experiments, there were no effects of verb class. Given that the postverbal *und* is a short word that is repeated in every sentence, it is not surprising that the interaction between object animacy and verb class corresponds to short absolute differences between the different conditions (15 ms for the simple main effect of object animacy in the accusative

conditions).

In summary, both kinds of deviation from prototypicaltransitivity (the presence of animate-animate sequences and the presence of noncanonical case marking verbs) have immediate and long-lasting effects on sentence comprehension in eyetracking and ERP measurements. As soon as verb class information is available, the processing of object animacy is modulated by the verb class.

6.3 Possible explanations for the interaction between verb class and object animacy

The results of the experiments presented in this thesis support the initial hypothesis that the effect of object animacy on the comprehension of transitive sentences is modulated by the verbal case marking pattern. However, the effects themselves do not explain which linguistic processes underly this interaction effect. In the following, I will propose a number of possible explanations. Each will focus on different aspects of sentence comprehension and on different underlying mechanisms. I assume that one of these explanations or a combination of several contributes to the interaction between object animacy and verb class effects[1].

Complement coercion of the inanimate NPs: Words can have different readings, depending on the context they appear in. For example, while the preferred reading of *book* is an entity, it can also be understood as an event (i.e., the writing of the book) if it is the argument of an event-selecting verb as in *The author began the book*. Eye tracking and MEG measurements have shown that these shifts to a dispreferred reading increase the processing cost during the comprehension of transitive sentences (Pylkkänen and McElree, 2007; Traxler et al., 2005, 2002, see Pylkkänen and McElree, 2006 for a review).

[1]The results of the first eyetracking study can also be interpreted as an influence of prelinguistic processes on the processing of object animacy contrasts. This explanation is discussed in detail in the Discussion of Chapter 4. Since the results obtained with ERP and reading time measurements do not suggest these very early interactions, I do not repeat this explanation here.

As I wrote in the Introduction, verbs assigning noncanonical NOM-DAT to their arguments can be assumed to also assign a nonprototypically transitive distribution of semantic properties to their arguments. It could therefore be argued that the dative-assigning verbs in my stimulus material coerce their objects into a reading that is more animate in order to fit their selectional restrictions. Under this assumption, the differences between the two verb classes and the interaction between verb class and animacy could be explained as an effect of complement coercion.

The inanimate NPs chosen as objects are not alive, and are not polysemous in the sense of referring to two unrelated entitites, one of which is animate while the other is not. However, some of them can be argued to have animate readings and can linguistically behave like animate beings. Political parties and corporations can be concerned, pursue goals and ask for support, and lectures are usually held by living lecturers. The object NPs in my stimulus sentences were lower on the animacy hierarchy than the subject NPs (Yamamoto, 1999), and the main effects of object animacy show that this animacy *contrast* was quite enough for the parser to notice the difference. Still, it is possible that the dative-assigning verbs systematically shift the meaning of their inanimate objects from the inanimate reading to one favouring the party members and lecturers. (This explanation implies that the interaction between object animacy and verb class is actually caused by an additional processing cost in the inanimate-dative condition compared to the animate-dative condition, and that the inanimate objects have different readings depending on the verb class. The lower processing cost for animate-inanimate argument sequences would be visible in the accusative condition, but would be canceled out in the dative condition by the increase in processing cost caused by the coercion of the inanimate argument NP.)

Interplay between inherent and derived semantic properties of the argument NPs during representation building: Like the explanation assuming complement coercion, this explanation assumes that the interaction reflects the non-prototypically transitive semantics of the dative-assigning verbs.

Animacy is an inherent semantic property of the NPs' referents. In a transitive sentence, the argument NPs bear the semantic properties assigned to them

by the verb in addition to their inherent semantic properties. Noncanonical case marking verbs like the NOM-DAT verbs used in my experiments assign a not-prototypically transitive distribution of semantic properties to their arguments: Their objects can roughly be described as being more agentive than the objects of prototypically transitive verbs. (See the Introduction for details.) It is therefore possible that the interactions between object animacy and verb class that I find in my studies reflect the interplay between the inherent semantic properties (i.e., the animacy status) and the derived semantic properties (i.e., the degree of agentivity) of the arguments. The degree of agentivity should be different for the objects of dative-assigning and accusative-assigning verbs, and I assume that a higher degree of agentivity should influence how animacy is processed.
Research in sentence production has shown that information that is conceptually more accessible (i.e., more easily retrieved from the mental lexicon) is processed first (Bock and Warren, 1985). This means that the argument with a conceptually more accessible referent is more likely to be realised as the grammatical subject of a sentence, and that the conceptual accessibility therefore influences the syntactic structure to be produced. The overall conceptual accessibility, in turn, is a combination of a referents' inherent conceptual accessibility (to which animacy is one contributing factor) and its derived conceptual accessibility (which is derived by the sentence and discourse context). Inherent and derived conceptual accessibility both influence the overall conceptual accessibility, and both combine in sentence production to influence the syntactic prominence of an argument and the word order of the final sentence (Branigan et al., 2008; Prat-Sala and Branigan, 2000).

I do not assume that sentence production and comprehension use exactly parallel processes. However, I assume that the properties of an argument that depend on the context (like the degree of agentivity) and those that are unchangeable (like animacy) should interact in sentence comprehension. Animate object NPs can be more agentive, which leads to increased processing costs in the context of an accusative-assigning verb. However, if the verb assigns dative and therefore makes its object more agentive, this could lead to an easier accomodation of the agentive properties assigned by the verb if the object is already animate. (I am not suggesting that the increased agentivity of the objects signaled by a dative

case marking completely licenses the object animacy. The main effects of object animacy that are visible on later reading time measures in eye tracking, and on the right hemisphere in the ERP experiment, suggest that the use of animacy contrasts is a robust processing strategy, which is modulated, but not stopped, when a dative-assigning verb is encountered.)

Restructuring the syntactic representations: The objects of NOM-DAT verbs live in different projections from the objects of NOM-ACC verbs. Once the dative-assigning verb is encountered, the parser has to change the syntactic representation of the sentence. The interaction between object animacy and verb class could also be explained as a syntactic phenomenon, indicating that the processing of argument animacy contrasts interacts with the restructuring of the syntactic representation.

The data presented in this thesis give mixed support for this explanation. The results of the eyetracking study on natural reading might suggest that the processing of argument animacy contrasts is merely put on hold once the dative-assigning verb becomes visible. This would explain why the first-pass times on the adverbs are longer in the animate-accusative condition than in the inanimate-accusative condition (reflecting the difficulty of integrating two NPs into a representation of the sentence, without having case marking or animacy contrasts), while the first-pass times on the adverbs are equally short in both dative conditions (argument animacy contrasts simply are not used during the processing of these sentences at this point in time, since the parser is processing the verb class information first). This would fit in well with the main effects of object animacy visible in later processing steps, like total reading times, at other positions - at this point in time, the parser can be assumed to have restarted the build-up of the representation of the sentence, using argument animacy contrasts again.

The ERP and self-paced reading time experiments do neither support nor contradict this explanation. In ERP studies, syntactic processing difficulties are usually associated with P600 components. However, a number of studies indicate that the revision of case marking information elicits enhanced N400 rather than P600 components (Bornkessel et al., 2004; Hopf et al., 1998).

It is important to note that under some analyses of the syntax of dative verbs, my dative-assigning verbs can be further divided into syntactic subgroups (see Haider 2010; McFadden 2004; Meinunger 2000, and the Introduction)[1]. While I omitted verbs with an unmarked DAT-NOM word order (which quite often are object-experiencer verbs not allowing inanimate objects anyway), I did not distinguish between the NOM-DAT verbs assigning the dative in the higher position (like *helfen* "to help") and the ones assigning dative in the lower position (like *folgen* "to follow", *ausweichen* "to avoid"). Bornkessel et al. (2004) have shown that the word order effects in sentence comprehension interact with the basic word orders of different dative verbs, contrasting DAT-NOM and 'active dative' NOM-DAT verbs. In keeping with the current practice in the psycholinguistic literature, I chose 'active' dative verbs without distinguishing between further subgroups. Since the basic word orders are the same for both subgroups of NOM-DAT verbs, and since they both deviate from NOM-ACC verbs, I assume that both subgroups should cause additional processing costs once they are encountered. However, in future studies it would be interesting to find out whether the distinction between high and low datives for noncanonical case marking verbs is psychologically real, and if this should be the case, whether the influence of different syntactic structures for active dative verbs has a measurable influence on sentence comprehension.

[1]These subgroups are only relevant for more detailed syntactic analyses; the semantic-thematic properties of different kinds of dative verbs should not be affected by the exact syntactic structure. See Meinunger 2007.

6.4 Conclusion

The hypothesis proposed in this dissertation was that the processing of argument animacy contrasts is modulated by verb class during sentence comprehension. The results of my experiments support this hypothesis, showing interactions between the effects of object animacy and verb class. The point in time when these interactions became visible depended on the experimental method chosen and on the presentation paradigm for the stimulus sentences. In general, the effect of object animacy was modulated as soon as verb class information became available.

In addition to the interactions, a number of main effects of object animacy successfully served as control effects, illustrating the time course of the processing of animacy contrasts in sentence comprehension. A smaller number of main effects of verb class were also visible. Both object animacy and verb class influence incremental representation building as soon as the relevant information becomes available, and lead to immediate and longlasting effects, suggesting that verb class and animacy influence early and late processing steps in sentence comprehension.

Zusammenfassung

Transitive Sätze beschreiben Situationen, in denen ein Teilnehmer etwas mit einem anderen Teilnehmer macht, wie z. B. *Peter tritt den Tisch.* Das Verb des Satzes (*treten*) beschreibt dabei das Ereignis und die Argumente (*Peter* und *der Tisch*) die Teilnehmer. Welche sprachliche Information erlaubt es uns, zu erkennen, wer in der beschriebenen Situation was mit wem gemacht hat? Welche sprachliche Information erlaubt es uns, den Teilnehmern in der Situation grammatische und thematische Rollen zuzuweisen? In der Psycholinguistik ist bekannt, dass transitive Sätze mit einem belebten Subjekt und einem unbelebten Objekt die geringsten Verarbeitungskosten verursachen. Dies lässt sich gut mit der Beobachtung verbinden, dass solche Sätze die natürlichste transitive Konstruktion in den Sprachen der Welt darstellen (vgl. Comrie 1989) und dass Abweichungen von diesem Muster in vielen Sprachen linguistisch markiert werden müssen. Ein Satz, der zwei belebte Argumente hat, verursacht demnach höhere Verarbeitungskosten als ein Satz, der ein belebtes und ein unbelebtes Argument hat. Sprachproduktionsstudien zeigen, dass Sprecher belebte Argumente als das grammatische Subjekt verwenden, auch wenn sie dafür kompliziertere Passivsätze produzieren müssen (z.B. Ferreira 1994). Studien zum Sprachverstehen zeigen, dass die Verarbeitungskosten für Sätze mit zwei belebten Argumenten höher sind als für solche mit einem belebten und einem unbelebten Argument. Objektbelebtheitseffekte für das Sprachverstehen sind mit Blickbewegungsstudien (Trueswell et al., 1994), EKP (Frisch and Schlesewsky, 2001) und fMRT (Grewe et al., 2007) nachgewiesen worden.

In der theoretischen Linguistik ist bekannt, dass nicht alle transitiven Verben den gleichen Grad an Transitivität aufweisen. Dies bedeutet, dass nicht alle Verben Situationen beschreiben, in denen die Argumente eindeutig als Agens oder

Patiens beschrieben werden können. Die nicht-prototypisch transitive Semantik eines Verbs kann sich auch in seinem syntaktischen Verhalten widerspiegeln (Dowty, 1991). In kasusmarkierenden Sprachen wie Deutsch ist ein Symptom von nicht-prototypischer Transitivität die nichtkanonische Kasusmarkierung (also Nominativ-Dativ statt Nominativ-Akkusativ). Ein Vergleich von Deutsch mit anderen kasusmarkierenden Sprachen zeigt, dass die Verben mit nichtkanonischer Kasusmarkierung immer nicht prototypisch transitive Ereignisse beschreiben (Blume, 2000). Ihre Subjekte sind weniger agentivisch, und ihre Objekte stärker agentivisch, als eine typische Agens-Patiens-Verteilung erfordern würde (Grimm, 2010; Meinunger, 2007). Die deutschen Nominativ-Dativ-zuweisenden Verben unterscheiden sich nicht nur semantisch, sondern auch syntaktisch von den prototypisch transitiven Akkusativ-zuweisenden Verben (z.B. Bayer et al. 2001) und verursachen höhere Verarbeitungskosten als diese (z.B. Bader et al. 2000; Bornkessel et al. 2004).

Fragestellung Die Argumente eines Dativverbs haben andere syntaktische und semantische Eigenschaften als die eines Akkusativverbs. Beeinflusst dieser Unterschied die Verarbeitung eines anderen Unterschieds, nämlich den zwischen belebten oder unbelebten Objekten (bei belebtem Subjekt)? Die meiner Arbeit zugrundeliegende Hypothese ist: Die Prozesse beim Sprachverstehen, die die Belebtheit der Argumente nutzen, interagieren mit den Prozessen, die die Verbklasse nutzen. Ein Satz mit zwei belebten Argumenten wird unterschiedlich verarbeitet, abhängig davon, ob das Verb dem Objekt Akkusativ oder Dativ zuweist.

In dieser Dissertation untersuchte ich die Verarbeitung von Sätzen in vier verschiedenen Bedingungen, in denen die Objektbelebtheit und verbale Kasuszuweisungsmuster variiert werden. Das Stimulusmaterial für die Experimente bestand aus Satzquartetten wie dem folgenden:

1. unbelebtes **Objekt**, Akkusativ-zuweisendes *Verb*:
   Tim glaubt, dass Tauben **Luftballons** gerne *mögen*, und Tom glaubt das auch.

2. belebtes **Objekt**, Akkusativ-zuweisendes *Verb*:
   Tim glaubt, dass Tauben **Krähen** gerne *mögen*, und ...

3. unbelebtes **Objekt**, Dativ-zuweisendes *Verb*:
   Tim glaubt, dass Tauben **Luftballons** gerne *folgen*, und ...

4. belebtes **Objekt**, Dativ-zuweisendes *Verb*:
   Tim glaubt, dass Tauben **Krähen** gerne *folgen*, und ...

Aufgrund der bisherigen psycholinguistischen Forschung kann vorausgesagt werden, dass Bedingung (2) im Kontrast zur Bedingung (1) höhere Verarbeitungskosten verursachen sollte. Die Hypothese sagt voraus, dass die Objektbelebtheit die Verarbeitung der Bedingung (4) im Kontrast zur Bedingung (3) anders beeinflusst als im Kontrast zwischen (2) und (1). Dies kann sich in schwächeren Objektbelebtheitseffekten oder in unterschiedlichen Zeitpunkten der Effekte während des Satzverstehens zeigen. Die hier vorgestellten Stimuli bildeten die Grundlage für alle in der Dissertation beschriebenen Experimente.

Lesezeitenstudie Eine Lesezeitenstudie (self-paced reading time study) mit 30 Probanden diente als Vorexperiment, um die Eignung des Stimulusmaterials für die untersuchte Fragestellung zu testen.

Ergebnis: Die Lesezeiten für das Verb sind in den Bedingungen mit belebten Objekten länger als in denen mit unbelebten Objekten. Auch die Lesezeit für das postverbale *und* ist nach einem belebten Objekt langsamer, wenn das Verb Akkusativ zuweist. Nach einem Dativverb jedoch beeinflusst die Objektbelebtheit die Lesezeit für das postverbale *und* nicht. Diese Interaktion zwischen den Effekten von Objektbelebtheit und verbalem Kasuszuweisungsmuster unterstützt die Ausgangshypothese.

Zwei Blickbewegungsstudien Die Auswertung der Lesezeitenstudie legte nahe, die Verarbeitung der Stimuli während des freien Lesens zu untersuchen. In

der ersten Blickbewegungsstudie wurden 54 Probanden getestet. Die Stimulussätze wurden als ganze Sätze auf einem Bildschirm präsentiert. Neben deutlichen Haupteffekten für Objektbelebtheit und Verbklasse zeigte die Blickbewegungsstudie einen Unterschied des Objektbelebtheitseffekts für verschiedene Verbklassen. Die frühen Lesezeiten auf dem präverbalen Adverb (im Beispiel *gerne*) sind nach belebten Objekten länger, wenn ein Akkusativverb folgt. Folgt jedoch ein Dativverb, spielt die Objektbelebtheit keine Rolle für die frühen Lesezeiten auf dem Adverb. Die Interaktion zwischen den Einflüssen der Objektbelebtheit und der Kasuszuweisung durch das Verb tritt zu einem früheren Zeitpunkt als während der Lesezeitenstudie auf. Das Ergebnis suggeriert, dass die relevante Information des Verbs beim Lesen schon während der parafovealen Wahrnehmung genutzt wird und das Leseverhalten auf dem präverbalen Adverb beeinflusst, bevor das Verb selbst direkt fixiert wird.

Ein zweites Lesezeitenexperiment mit 54 Probanden sollte sicherstellen, dass der beobachtete Effekt wirklich parafoveale Wahrnehmung widerspiegelt und nicht durch Messfehler der unerwartet frühen Position im Satz zugeordnet wird. In diesem Experiment wurden die gleichen Stimulussätze wie im ersten Eyetrackingexperiment in einem boundary-Paradigma (Rayner, 1975) präsentiert. Hierbei werden die Wörter des Satzes durch Wörter mit ähnlichen Silhouetten maskiert. Ein Wort erscheint erst in seiner richtigen Gestalt, wenn ein Proband das Wort für mindestens fünf ms direkt fixiert hatte. So war während der Fixierung von Wort n die parafoveale Wahrnehmung von Wort n+1 nicht möglich.

In der zweiten Studie zeigten sich keine Interaktionen zwischen Objektbelebtheit und Verbklasse mehr. Auch der zeitliche Ablauf der verschiedenen Haupteffekte ist im boundary-Paradigma etwas anders als beim freien Lesen. Das zweite Eyetrackingexperiment bestätigt, dass der Interaktion im ersten Eyetrackingexperiment kein grober Messfehler zugrundeliegt.

EKP-Studie Die Ergebnisse der Blickbewegungstudien und der Lesezeitenstudie erlauben eine Messung des Leseverhaltens als Reaktion auf bestimmte Stimuli. Daraus kann indirekt auf die Sprachverarbeitungsprozesse geschlossen werden, die dieses Verhalten steuern. Die Messung von EKPs (ereigniskorrelierten Potentialen) erlaubt eine millisekundengenaue Auflösung der Spannungs-

veränderungen auf der Schädeloberfläche, die durch die Hirnaktivität beim Lesen entstehen. In der EKP-Studie wurden 20 Probanden beim Lesen einer Wort-für-Wort-Präsentation der Stimuli getestet. Die Analyse der EKP-Daten zeigt, dass sich während der Präsentation der Akkusativ-zuweisenden Verben ein Effekt der Objektbelebtheit messen lässt. In den Elektroden der links-posterioren Region verlaufen die gemessenen Spannungen im Zeitfenster von 400 bis 600 ms nach der Präsentation eines Akkusativverbs negativer, wenn das vorhergehende Objekt belebt war, als wenn es unbelebt war. Diesen Unterschied interpretiere ich als eine Verstärkung der N400-Komponente, die als Reaktion auf Schwierigkeiten bei der thematischen Rollenzuweisung bekannt ist (Frisch and Schlesewsky, 2001). Dieser Unterschied lässt sich für Dativverben nicht feststellen; die Spannungskurven verlaufen nach unbelebten und belebten Objekten bei ähnlich negativen Werten wie für die belebt-akkusativ-Bedingung. Die hier beschriebene Interaktion zwischen Verbklasse und Objektbelebtheit ist nur auf links-posterioren Elektroden sichtbar. Auf rechts-posterioren Elektroden hingegen zeigt sich nur ein Haupteffekt für Objektbelebtheit unabhängig von der Verbklasse, mit negativeren Spannungskurven im Zeitfenster von 400 bis 600 ms nach belebten Objekten.

Fazit Alle drei verwendeten Methoden zeigten robuste Haupteffekte der Objektbelebtheit, und alle Studien außer der Lesezeitenstudie zeigten Haupteffekte der Verbklasse. Diese Haupteffekte dienen als Kontrolleffekte und zeigen, dass sich Objektbelebtheitseffekte mit den verwendeten Methoden und Stimuli nachweisen lassen.

Zusätzlich zu diesen Kontrollergebnissen zeigten alle verwendeten Methoden (und alle Experimente bis auf die Blickbewegungsstudie mit boundary-Paradigma) eine Interaktion von Objektbelebtheit und Verbklasse. Der Effekt der Objektbelebtheit auf die Verarbeitung von transitiven Sätzen wird vom verbalen Kasuszuweisungsmuster moduliert. Dies bestätigt die der Arbeit zugrundeliegende Ausgangshypothese, dass während des Satzverstehens die Objektbelebtheit und das verbale Kasuszuweisungsmuster interagieren. Verschiedene linguistische Prozesse könnten diese Interaktion erklären. Eine mögliche Erklärung ist die Interaktion zwischen den inhärenten semantischen Eigenschaften der Objekte (wie Belebtheit) und ihren in der spezifischen Situation zugewiesenen semantischen

Eigenschaften (wie erhöhte Agentivität im Fall von Dativobjekten). Ein weitere mögliche Erklärung ist, dass in der Unbelebt-Dativ-Bedingung zusätzliche Verarbeitungskosten auftreten, weil die Dativverben eine belebtere Lesart der *unbelebten* Objekte auslösen (*complement coercion*). Schließlich wäre es denkbar, dass die Verarbeitung von Objektbelebtheitskontrasten interagiert mit der syntaktischen Restrukturierung des Satzes, die durch die Dativverben nötig wird.

Die unterschiedlichen Methoden zeigen Interaktionseffekte zu unterschiedlichen Zeitpunkten während des Satzverstehens. Dies weist darauf hin, dass das Satzverstehen stark von Art der Stimuluspräsentation beeinflusst wird. Im Allgemeinen zeigt sich, dass die Objektbelebtheitseffekte moduliert werden, sobald die Verbklasseninformation zugänglich ist.

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Appendix 1: Language material

This Appendix lists all critical sentences used in the experiments.

(1) a. Kathrin behauptet, dass Banditen Postkutschen häufig
Kathrin claims that bandit.PL.(NOM) stagecoach.PL.(ACC) frequently
ausrauben, und Max behauptet das auch.
rob.3PL and Max claims that too
Kathrin claims that bandits frequently rob stage coaches, and Max claims that, too.

b. Samira behauptet, dass Banditen Postboten häufig
Samira claims that bandit.PL.(NOM) postman.PL.(ACC) frequently
ausrauben, und Emma behauptet das auch.
rob.3PL and Emma claims that too
Samira claims that bandits frequently rob postmen, and Emma claims that, too.

c. Daniel behauptet, dass Banditen Postkutschen häufig
Daniel claims that bandit.PL.(NOM) stagecoach.PL.(DAT) frequently
auflauern, und Dominik behauptet das auch.
waylay.3PL and Emma claims that too
Daniel claims that bandits frequently waylay stage coaches, and Emma claims that, too.

d. Tommi behauptet, dass Banditen Postboten häufig
Tommi claims that bandit.PL.(NOM) postman.PL.(DAT) frequently
auflauern, und Susanne behauptet das auch.
waylay.3PL and Susanne claims that too
Tommi claims that bandits frequently waylay postmen, and Susanne claims that, too.

(2) a. Peter behauptet, dass Studentinnen Vorlesungen begeistert
Peter claims that student.FEM.PL.(NOM) lecture.PL.(ACC) enthusiastically
loben, und Ida behauptet das auch.
praise.3PL and Ida claims that too

Peter claims that students enthusiastically praise lectures, and Ida claims that, too.

b. Sven behauptet, dass Studentinnen Professoren begeistert
Sven claims that student.FEM.PL.(NOM) professor.PL.(ACC) enthusiastically
loben, und Andreas behauptet das auch.
praise.3PL and Andreas claims that too
Sven claims that students enthusiastically praise professors, and Andreas claims that, too.

c. Mia behauptet, dass Studentinnen Vorlesungen begeistert
Mia claims that student.FEM.PL.(NOM) lecture.PL.(DAT) enthusiastically
applaudieren, und Jan behauptet das auch.
applaud.3PL and Jan claims that too
Mia claims that students enthusiastically applaud lectures, and Jan claims that, too.

d. Jan behauptet, dass Studentinnen Professoren begeistert
Jan claims that student.FEM.PL.(NOM) professor.PL.(DAT) enthusiastically
applaudieren, und Tim behauptet das auch.
applaud.3PL and Tim claims that too
Jan claims that students enthusiastically applaud professors, and Tim claims that, too.

(3) a. Anja bezweifelt, dass Beraterinnen Strategien sofort
Anja doubts that consultant.FEM.PL.(NOM) strategy.PL.(ACC) immediately
verstehen, und Caro bezweifelt das auch.
understand.3PL and Caro doubts that too
Anja doubts that consultants immediately understand strategies, and Caro doubts that, too.

b. Tobi bezweifelt, dass Beraterinnen Praktikanten sofort
Tobi doubts that consultant.FEM.PL.(NOM) intern.PL.(ACC) immediately
verstehen, und Marek bezweifelt das auch.
understand.3PL and Marek doubts that too
Tobi doubts that consultants immediately understand interns, and Marek doubts that, too.

c. Björn bezweifelt, dass Beraterinnen Strategien sofort
Björn doubts that consultant.FEM.PL.(NOM) strategy.PL.(DAT) immediately
zustimmen, und Philipp bezweifelt das auch.
agree.with.3PL and Philipp doubts that too
Björn doubts that consultants immediately agree with strategies, and Philipp doubts

that, too.

d. Arne bezweifelt, dass Beraterinnen Praktikanten sofort
Arne doubts that consultant.FEM.PL.(NOM) intern.PL.(DAT) immediately
zustimmen, und Lukas bezweifelt das auch.
agree.with.3PL and Lukas doubts that too

Arne doubts that consultants immediately agree with interns, and Lukas doubts that, too.

(4) a. Leo denkt, dass Direktoren Strategien schnell verstehen, und
Leo thinks that director.PL.(NOM) strategy.PL.(ACC) quickly understand.3PL and
Bernd denkt das gleiche.
Bernd thinks the same

Leo thinks that directors quickly understand strategies and Bernd thinks so, too.

b. Lydia denkt, dass Direktoren Sekretärinnen schnell
Lydia thinks that director.PL.(NOM) secretary.FEM.PL.(ACC) quickly
verstehen, und Jan denkt das gleiche.
understand.3PL and Jan thinks the same

Lydia thinks that directors quickly understand secretaries, and Jan thinks so, too.

c. Jakob denkt, dass Direktoren Strategien schnell zustimmen,
Jakob thinks that director.PL.(NOM) strategy.PL.(DAT) quickly agree.with.3PL
und Hannah denkt das gleiche.
and Hannah thinks the same

Jakob thinks that directors quickly agree with strategies, and Hannah thinks so, too.

d. Sabrina denkt, dass Direktoren Sekretärinnen schnell
Sabrina thinks that director.PL.(NOM) secretary.FEM.PL.(DAT) quickly
zustimmen, und Simone denkt das gleiche.
agree.with.3PL and Simone thinks the same

Sabrina thinks that directors quickly agree with secretaries and Simone thinks so, too.

(5) a. Kerstin glaubt, dass Sängerinnen Anfeindungen gelassen aushalten,
Kerstin believes that singer.FEM.PL.(NOM) hostility.PL.(ACC) calmly endure.3PL
und Miriam glaubt das auch.
and Miriam believes that too

Kerstin believes that singers calmly bear hostilities, and Miriam believes it, too.

b. Kilian glaubt, dass Sängerinnen Dirigenten gelassen
Kilian believes that singer.FEM.PL.(NOM) conductor.PL.(ACC) calmly
aushalten, und Anna glaubt das auch.
endure.3PL and Anna believes that too
Kilian believes that singers calmly bear conductors, and Anna believes that, too.

c. Mirka glaubt, dass Sängerinnen Anfeindungen gelassen standhalten,
Mirka believes that singer.FEM.PL.(NOM) hostility.PL.(DAT) calmly resist.3PL
und Johanna glaubt das auch.
and Johanna believes that too.
Mirka believes that singers calmly resist hostilities, and Johanna believes that, too.

d. Paul glaubt, dass Sängerinnen Dirigenten gelassen standhalten,
Paul believes that singer.FEM.PL.(NOM) conductor.PL.(DAT) calmly resist.3PL
und Alex glaubt das auch.
and Alex believes that too.
Paul believes that singers calmly resist conductors, and Alex believes that, too.

(6) a. Kati berichtet, dass Allergikerinnen Zigaretten häufig
Kati relates that allergic.person.FEM.PL.(NOM) cigarette.PL.(ACC) frequently
verfluchen, und Mari berichtet das auch.
curse.3PL and Mari relates that too.
Kati tells that allergic people frequently curse cigarettes, and Mari tells the same.

b. Rita berichtet, dass Allergikerinnen Katzen häufig
Rita relates that allergic.person.FEM.PL.(NOM) cat.PL.(ACC) frequently
verfluchen, und Fred berichtet das auch.
curse.3PL and Fred relates that too.
Rita tells that allergic people frequently curse cats, and Fred tells the same.

c. Egon berichtet, dass Allergikerinnen Zigaretten häufig
Egon relates that allergic.person.FEM.PL.(NOM) cigarette.PL.(DAT) frequently
abschwören, und Simon berichtet das auch.
swear.off.3PL and Simon relates that too.
Egon tells that allergic people often swear off cigarettes, and Simon tells the same.

d. Henk berichtet, dass Allergikerinnen Katzen häufig
Henk relates that allergic-person.FEM.PL.(NOM) cat.PL.(DAT) frequently
abschwören, und Nele berichtet das auch.
swear.off.3PL and Nele relates that too.
Henk tells that allergic people often swear off cats, and Nele tells the same.

(7) a. Tim glaubt, dass Tauben Luftballons gerne mögen, und Tom
Tim believes that dove.PL.(NOM) airballoon.PL.(ACC) gladly like.3PL and Tom
glaubt das auch.
believes that too

Tim believes that doves rather like balloons, and Tom believes that, too.

b. Julian glaubt, dass Tauben Krähen gerne mögen, und Horst
Julian believes that dove.PL.(NOM) crow.PL.(ACC) gladly like.3PL and Horst
glaubt das auch.
believes that too.

Julian believes that doves rather like crows, and Horst believes that, too.

c. Gabi glaubt, dass Tauben Luftballons gerne folgen, und Else
Gabi believes that dove.PL.(NOM) airballoon.PL.(DAT) gladly follow.3PL and Else
glaubt das auch.
believes that too

Gabi believes that doves like following balloons, and Else believes that, too.

d. Tim glaubt, dass Tauben Krähen gerne folgen, und Tom
Tim believes that dove.PL.(NOM) crow.PL.(DAT) gladly follow.3PL and Tom
glaubt das auch.
believes that, too.

Tim believes that doves like following crows, and Tom believes that, too.

(8) a. Annika glaubt, dass Pfadfinderinnen Schatzkarten immer
Annika believes that path-finder.FEM.PL.(NOM) treasure-map.PL.(ACC) always
mögen, und Julia glaubt das auch.
like.3PL and Julia believes that, too.

Annika believes that girl scouts always like treasure maps, and Julia believes that, too.

b. Mark glaubt, dass Pfadfinderinnen Anführerinnen immer
Mark believes that path-finder.FEM.PL.(NOM) leader.FEM.PL.(ACC) always
mögen, und Ronnie glaubt das auch.
like.3PL and Ronnie believes that, too.

Mark believes that girl scouts always like [scout] leaders, and Ronnie believes that, too.

c. Jenny glaubt, dass Pfadfinderinnen Schatzkarten immer
Jenny believes that path-finder.FEM.PL.(NOM) treasure-map.PL.(DAT) always
folgen, und Max glaubt das auch.
follow.3PL and Max believes that, too.

Jenny believes that girl scouts always follow treasure maps, and Max believes that, too.

d. Tim glaubt, dass Pfadfinderinnen Anführerinnen immer
Tim believes that path-finder.FEM.PL.(NOM) leader.FEM.PL.(DAT) always
folgen, und Tom glaubt das auch.
follow.3PL and Julia believes that, too.
Tim believes that girl scouts always follow the leader, and Julia believes that, too.

(9) a. Suse behauptet, dass Richterinnen Alibis häufig ablehnen,
Suse claims that judge.FEM.PL.(NOM) alibi.PL.(ACC) frequently reject.3PL
und Freddie behauptet das gleiche.
and Freddie claims the same.
Suse claims that judges frequently reject alibis, and Freddie claims that, too.

b. Manuela behauptet, dass Richterinnen Zeuginnen häufig
Manuela claims that judge.FEM.PL.(NOM) witness.FEM.PL.(ACC) frequently
ablehnen, und Torsten behauptet das gleiche.
reject.3PL and Torsten claims the same.
Manuela claims that judges frequently reject witnesses, and Torsten claims that, too.

c. Frieke behauptet, dass Richterinnen Alibis häufig
Frieke claims that judge.FEM.PL.(NOM) alibi.PL.(DAT) frequently
misstrauen, und Anna behauptet das gleiche.
distrust.3PL and Anna claims the same.
Frieke claims that judges frequently distrust alibis, and Anna claims that, too.

d. Nadja behauptet, dass Richterinnen Zeuginnen häufig
Nadja claims that judge.FEM.PL.(NOM) witness.FEM.PL.(DAT) frequently
misstrauen, und Linus behauptet das gleiche.
distrust.3PL and Linus claims the same.
Nadja claims that judges frequently distrust witnesses, and Linus claims that, too.

(10) a. Marion sagt, dass Sekretärinnen Firmen ungern
Marion says that secretary.FEM.PL.(NOM) company.PL.(ACC) reluctantly
anzeigen, und Karla sagt das gleiche.
report.3PL and Karla says the same
Marion says that secretaries dislike reporting companies [to the police], and Karla says so, too.

b. Henning sagt, dass Sekretärinnen Kollegen ungern
Henning that secretary.FEM.PL.(NOM) colleague.PL.(ACC) reluctantly report.3PL
anzeigen, und Hannes sagt das gleiche.
and Hannes says the same

Henning says that secretaries dislike reporting colleagues [to the police], and Hannes says so, too.

c. Ute sagt, dass Sekretärinnen Firmen ungern schaden,
Ute says that secretary.FEM.PL.(NOM) company.PL.(DAT) reluctanty damage.3PL
und Elke sagt das gleiche.
and Elke says the same

Ute says that secretaries dislike doing damage to companies, and Elke says so, too.

d. Udo sagt, dass Sekretärinnen Kollegen ungern
Udo says that secretary.FEM.PL.(NOM) colleague.PL.(DAT) reluctantly
schaden, und Simone sagt das gleiche.
damage.3PL and Simone says the same

Udo says that secretaries dislike doing damage to colleagues, and Simone says so, too.

(11) a. Teresa erzählt, dass Mädchen Karnevalswagen begeistert
Teresa tells that girl.PL.(NOM) carnival-wagon.PL.(ACC) enthusiastically
anstarren, und Roland erzählt das gleiche.
stare.at.3PL and Roland tells the same

Teresa tells that girls enthusiastically stare at carnival floats, and Roland tells the same.

b. Peter erzählt, dass Mädchen Karnevalsprinzen begeistert
Peter tells that girl.PL.(NOM) carnival-prince.PL.(ACC) enthusiastically
anstarren, und Lisa erzählt das gleiche.
stare.at.3PL and Lisa tells the same

Peter tells that girls enthusiastically stare at carnival princes, and Lisa tells the same.

c. Hannes erzählt, dass Mädchen Karnevelswagen begeistert
Hannes tells that girl.PL.(NOM) carnival-wagon.PL.(DAT) enthusiastically
zujubeln, und Malte erzählt das gleiche.
cheer.at.3PL and Malte tells the same

Hannes tells that girls enthusiastically hail carnival floats, and Malte tells the same.

d. Antje erzählt, dass Mädchen Karnevalsprinzen begeistert
Antje tells that girl.PL.(NOM) carnival-prince.PL.(DAT) enthusiastically

zujubeln, und Mareike erzählt das gleiche.
cheer.at.3PL and Mareike tells the same
Antje tells that girls enthusiastically hail carnival princes, and Mareike tells the same.

(12) a. Hagen stört, dass Menschen Paraden begeistert
Hagen is.bothered that human.PL.(NOM) parade.PL.(ACC) enthusiastically
besingen, und Stefan stört es auch
sing.about3PL and Stefan is.bothered it too
Hagen is bothered that people excitedly sing about parades, and Stefan is bothered by it, too.

b. Lea stört, dass Menschen Diktatoren begeistert
Lea is.bothered that human.PL.(NOM) dictator.PL.(ACC) enthusiastically
besingen, und Hans stört es auch.
sing.about3PL and Hans is.bothered it too
Lea is bothered that people excitedly sing about dictators, and Hans is bothered by it, too.

c. Mareike stört, dass Menschen Paraden begeistert
Mareike is.bothered that human.PL.(NOM) parade.PL.(DAT) enthusiastically
zujubeln, und Johanna stört es auch.
cheer.at.3PL and Johanna is.bothered it too
Mareike is bothered that people enthusiastically hail parades, and Johanna is bothered by it, too.

d. Dirk stört, dass Menschen Diktatoren begeistert
Dirk is.bothered that human.PL.(NOM) dictator.PL.(DAT) enthusiastically
zujubeln, und Wiebke stört es auch.
cheer.at.3PL and Wiebke is.bothered it too
Dirk is bothered that people enthusiastically hail dictators and Wiebke is bothered by it, too.

(13) a. Maria beobachtet, dass Buben Lastwagen lange anglotzen, und Hans
Maria observes that boy.PL.(NOM) lorry.PL.(ACC) long stare.at.3PL and Hans
beobachtet das auch.
observes that too
Maria observes that boys stare at lorries for a long time, and Hans observes that, too.

b. Henrik beobachtet, dass Buben Katzen lange anglotzen, und
Henrik observes that boy.PL.(NOM) cat.PL.(ACC) long stare.at.3PL and

Martha beobachtet das auch.
Martha observes that too

Henrik observes that boys stare at cats for a long time, and Martha observes that, too.

c. Klaus beobachtet, dass Buben Lastwagen lange nachglotzen, und
Klaus observes that boy.PL.(NOM) lorry.PL.(DAT) long stare.after.3PL and
Otto beobachtet das auch.
Otto observes that too

Klaus observes that boys stare after lorries for a long time, and Otto observes that, too.

d. Christoph beobachtet, dass Buben Katzen lange nachglotzen, und
Christoph observes that boy.PL.(NOM) cat.PL.(DAT) long stare.after.3PL and
Werner beobachtet das auch..
Werner observes that too

Christoph observes that boys stare after cats for a long time and Werner observes that, too.

(14) a. Nina sagt, dass Mädchen Autos lange anglotzen, und Hans sagt das
Nina says that girl.PL.(NOM) car.PL.(ACC) long stare.at.3PL and Hans says that
auch.
too

Nina says that girls stare at cars for a long time, and Hans says so, too.

b. Florian sagt, dass Mädchen Jungen lange anglotzen, und Felix sagt
Florian says that girl.PL.(NOM) boy.PL.(ACC) long stare.at.3PL and Felix says
das auch.
that too

Florian says that girls stare at boys for a long time, and Felix says so, too.

c. Antje sagt, dass Mädchen Autos lange nachglotzen, und Kerstin
Antje says that girl.PL.(NOM) car.PL.(DAT) long stare.after.3PL and Kerstin
sagt das auch.
says that too

Antje says that girls stare after cars for a long time, and Kerstin says so, too.

d. Sabine sagt, dass Mädchen Jungen lange nachglotzen, und Anne sagt
Sabine says that girl.PL.(NOM) boy.PL.(DAT) long stare.after.3PL and Anne says
das auch.
that too

Sabine says that girls stare after boys for a long time, and Anne says so, too.

(15) a. Kathrin erzählt, dass Krähen Luftballons misstrauisch ansehen,
Kathrin tells that crow.PL.(NOM) air-balloon.PL.(ACC) suspiciously watch.3PL
und Maja erzählt das auch.
and Maja tells that too
Kathrin tells that crows suspiciously watch balloons, and Maja tells that, too.

b. Anja erzählt, dass Krähen Eulen misstrauisch ansehen, und
Anja tells that crow.PL.(NOM) owl.PL.(ACC) suspiciously watch.3PL and
Thomas erzählt das auch.
Thomas tells that, too.
Anja tells that crows suspiciously watch owls, and Thomas tells that, too.

c. Vera erzählt, dass Krähen Luftballons misstrauisch
Vera tells that crow.PL.(NOM) air-balloon.PL.(DAT) suspicously
nachsehen, und Peter erzählt das auch.
watch.after.3PL and Peter tells that too
Vera tells that crows suspicously look after balloons [that move away] and Peter tells that, too.

d. Ute erzählt, dass Krähen Eulen misstrauisch nachsehen, und
Ute tells that crow.PL.(NOM) owl.PL.(DAT) suspiciously watch.after.3PL and
Elke erzählt das auch.
Elke tells that too
Ute tells that crows suspiciously look after crows [that move away] and Elke tells that, too.

(16) a. Florian meint, dass Ärztinnen Irrlehren nachdrücklich
Florian supposes that doctor.FEM.PL.(NOM) heterodoxy.PL.(ACC) insistently
verteidigen, und Petra meint das auch.
defend.3PL, and Petra supposes that too
Florian supposes that doctors insistently defend heterodoxies, and Petra supposes so, too.

b. Ana meint, dass Ärztinnen Krankenpflegerinnen nachdrücklich
Ana supposes that doctor.FEM.PL.(NOM) nurse.FEM.PL.(ACC) insistently
verteidigen, und Max meint das auch.
defend.3PL and Max supposes that too
Ana supposes that doctors inistently defend nurses, and Max supposes so, too.

c. Gabi meint, dass Ärztinnen Irrlehren nachdrücklich
Gabi supposes that doctor.FEM.PL.(NOM) heterodoxy.PL.(DAT) insistently
widersprechen, und Andrea meint das auch.
contradict.3PL and Andrea supposes that too

Gabi supposes that doctors emphatically contradict heterodoxies, and Andrea supposes so, too.

d. Rudi meint, dass Ärztinnen Krankenpflegerinnen nachdrücklich
Rudi supposes that doctor.FEM.PL.(NOM) nurse.FEM.PL.(DAT) insistently
widersprechen, und Pia meint das auch.
contradict.3PL and Pia supposes that too

Rudi supposes that doctors emphatically contradict nurses, and Pia supposes so, too.

(17) a. Norbert hofft, dass Politikerinnen Bestechungen prinzipiell
Norbert hopes that politician.FEM.PL.(NOM) bribe.PL.(ACC) principally
ablehnen, und Karin hofft das auch.
reject.3PL and Karin hopes that too

Norbert hopes that politicians reject of bribes as a matter of principle, and Karin hopes so, too.

b. Toni hofft, dass Politikerinnen Baulöwen prinzipiell
Toni hopes that politician.FEM.PL.(NOM) build-lion(ACC).PL principally
ablehnen, und Michael hofft das auch.
reject.3PL and Michael hopes that too

Toni hopes that politicians reject building tycoons as a matter of principle, and Michael hopes so, too.

c. Vroni hofft, dass Politikerinnen Bestechungen problemlos
Vroni hopes that politician.FEM.PL.(NOM) bribe.PL.(DAT) problem-less
widerstehen, und Karin hofft das auch.
resist.3PL and Karin hopes that too

Vroni hopes that politicians resist bribes without difficulty and Karin hopes so, too.

d. Emanuel hofft, dass Politikerinnen Baulöwen problemlos
Emanuel hopes that politician.FEM.PL.(NOM) build-lion.PL.(DAT) problem-less
widerstehen, und Saskia hofft das auch.
resist.3PL and Saskia hopes that too

Emanuel hopes that politicians resist building tycoons without difficulty and Saskia hopes so, too.

(18) a. Nicole denkt, dass Schülerinnen Unannehmlichkeiten selten vergessen,
Nicole thinks that pupil.FEM.PL.(NOM) inconvenience.PL.(ACC) rarely forget.3PL
und Daniel denkt es auch.
and Daniel thinks it too
Nicole thinks that pupils rarely forget inconveniences, and Daniel thinks so, too.

b. Michael denkt, dass Schülerinnen Lehrerinnen selten vergessen,
Michael thinks that pupil.FEM.PL.(NOM) teacher.FEM.PL.(ACC) rarely forget.3PL
und Claudia denkt es auch.
and Claudia thinks it too
Michael thinks that pupils rarely forget teachers, and Claudia thinks so, too.

c. Jessica denkt, dass Schülerinnen Unannehmlichkeiten selten
Jessica thinks that pupil.FEM.PL.(NOM) inconvenienve.PL.(DAT) rarely
begegnen, und Dominik denkt es auch.
encounter.3PL and Dominik thinks it too
Jessica thinks that pupils rarely encounter inconveniences, and Dominik thinks so, too.

d. Marina denkt, dass Schülerinnen Lehrerinnen selten
Marina thinks that pupil.FEM.PL.(NOM) teacher.FEM.PL.(DAT) rarely
begegnen, und Wolfgang denkt es auch.
encounter.3PL and Wolfgang thinks it too
Marina thinks that pupils rarely encounter teachers, and Wolfgang thinks so, too.

(19) a. Basti glaubt, dass Polizisten Schwierigkeiten selten vergessen, und
Basti believes that policeman.PL.(NOM) difficulty.PL.(ACC) rarely forget.3PL and
Christian glaubt das auch.
Christian believes that too
Basti believes that policemen rarely forget difficulties, and Christian believes that, too.

b. Daniel glaubt, dass Polizisten Kollegen selten vergessen,
Daniel believes that policeman.PL.(NOM) colleague.PL.(ACC) rarely forget.3PL
und Mia glaubt das auch.
and Mia believes that too
Daniel believes that policemen rarely forget colleagues, and Mia believes that, too.

c. Petra glaubt, dass Polizisten Schwierigkeiten selten begegnen,
Petra believes that policeman.PL.(NOM) difficulty.PL.(DAT) rarely encounter.3PL
und Karin glaubt das auch.
and Karin believes that too.

Petra believes that policemen rarely encounter difficulties, and Karin believes that, too.

d. Stefan glaubt, dass Polizisten Kollegen selten
Stefan believes that policeman.PL.(NOM) colleagues.PL.(DAT) rarely
begegnen, und Basti glaubt das auch.
encounter.3PL and Basti believes that too
Stefan believes that policemen rarely encounter colleagues and Basti believes that, too.

(20) a. Matthias hofft, dass Patienten Anweisungen selten verspotten,
Matthias hopes that patient.PL.(NOM) instruction.PL.(ACC) rarely mock.3PL
und Tina hofft es auch.
and Tina hopes it too
Matthias hopes that patients rarely mock [doctor's] orders, and Tina hopes so, too.

b. Julia hofft, dass Patienten Ärztinnen selten verspotten, und
Julia hopes that patient.PL.(NOM) doctor.FEM.PL.(ACC) rarely mock and
Karsten hofft es auch.
Karsten hopes it too
Julia hopes that patients rarely mock doctors, and Karsten hopes so, too.

c. Robert hofft, dass Patienten Anweisungen selten zuwiderhandeln,
Robert hopes that patient.PL.(NOM) instruction.PL.(DAT) rarely counteract.3PL
und Nele hofft es auch.
and Nele hopes it too
Robert hopes that patients rarely act against [doctor's] orders, and Nele hopes so, too.

d. Benno hofft, dass Patienten Ärztinnen selten zuwiderhandeln,
Benno hopes that patient.PL.(NOM) doctor.FEM.PL.(DAT) rarely counteract.3PL
und Sina hofft es auch.
and Sina hopes it too
Benno hopes that patients rarely act against doctors, and Sina hopes so, too.

(21) a. Rita glaubt, dass Schülerinnen Anweisungen oft verspotten,
Rita believes that pupil.FEM.PL.(NOM) instruction.PL.(ACC) often mock.3PL
und Max glaubt das auch.
and Max believes that too
Rita believes that pupils often mock instructions, and Max believes that, too.

b. Moritz glaubt, dass Schülerinnen Lehrerinnen oft verspotten,
Moritz believes that pupil.FEM.PL.(NOM) teacher.FEM.PL.(ACC) often mock.3PL
und Berti glaubt das auch.
and Berti believes that, too.
Moritz believes that pupils often mock teachers, and Bert believes that, too.

c. Boris glaubt, dass Schülerinnen Anweisungen oft
Boris believes that pupil.FEM.PL.(NOM) instruction.PL.(DAT) often
zuwiderhandeln, und Suse glaubt das auch.
counteract.3PL and Suse believes that too
Boris believes that pupils often act against instructions, and Suse believes that, too.

d. Steffi glaubt, dass Schülerinnen Lehrerinnen oft
Suse believes, that pupil.FEM.PL.(NOM) teacher.FEM.PL.(DAT) often
zuwiderhandeln, und Mirko glaubt das auch.
counteract.3PL and Mirko believes that too.
Suse believes that pupils often act against teachers, and Mirko believes that, too.

(22) a. Karsten sieht, dass Radfahrerinnen Baustellen geschickt
Karsten sees that cyclist.FEM.PL.(NOM) build-site.PL.(ACC) deftly
vermeiden, und Martin sieht das auch.
avoid.3PL and Martin sees it, too.
Karsten sees that cyclists deftly avoid construction sites, and Martin sees it, too.

b. Toni sieht, dass Radfahrerinnen Polizisten geschickt vermeiden,
Toni sees that cyclists.FEM.PL.(NOM) policeman.PL.(ACC) deftly avoid.3PL
und Suse sieht das auch.
and Suse sees that too
Toni sees that cyclists deftly avoid policemen, and Suse sees it, too.

c. Otto sieht, dass Radfahrerinnen Baustellen geschickt ausweichen,
Otto sees that cyclist.FEM.PL.(NOM) build-site.PL.(DAT) deftly dodge.3PL
und Rainer sieht das auch.
and Rainer sees that too
Otto sees that cyclists deftly dodge construction sites, and Rainer sees it, too.

d. Michael sieht, dass Radfahrerinnen Polizisten geschickt ausweichen,
Michael sees that cyclist.PL.(NOM) policemen.PL.(DAT) deftly dodge.3PL
und Andreas sieht das auch.
and Andreas sees it too
Michael sees that cyclists deftly dodge policemen, and Andreas sees it, too.

(23) a. Robert hofft, dass Eltern Beschwerden aufmerksam
Robert hopes that parent.PL.(NOM) complaint.PL.(ACC) attentitvely
anhören, und Max hofft das auch.
listen.to.3PL and Max hopes that too
Robert hopes that parents attentively listen to complaints, and Max hopes so, too.

b. Lena hofft, dass Eltern Lehrerinnen aufmerksam
Lena hopes that parent.PL.(NOM) teacher.FEM.PL.(ACC) attentively
anhören, und Miriam hofft das auch.
listen.to.3PL and Miriam hopes that too
Lena hopes that parents attentively listen to teachers, and Miriam hopes so, too.

c. Björn hofft, dass Eltern Beschwerden aufmerksam zuhören,
Björn hopes that parent.PL.(NOM) complaint.PL.(DAT) attentively listen.to.3PL
und Anna hofft das auch.
and Anna hopes that too
Björn hopes that parents attentively listen to complaints, and Anna hopes so, too.

d. Hannes hofft, dass Eltern Lehrerinnen aufmerksam zuhören,
Hannes hopes that parent.PL.(NOM) teacher.PL.(ACC) attentively listen.to.3PL
und Katja hofft das auch.
and Katja hopes that, too.
Hannes hopes that parents attentively listen to teachers, and Katja hopes so, too.

(24) a. Frauke beobachtet, dass Wirtinnen Schilderungen
Frauke observes that innkeeper.FEM.PL.(NOM) description.PL.(ACC)
aufmerksam anhören, und Mo beobachtet das auch.
attentively listen.to.3PL and Mo observes that too
Frauke observes that innkeepers attentively listen to descriptions, and Mo observes that, too.

b. Richard beobachtet, dass Wirtinnen Matrosen aufmerksam
Richard observes that innkeeper.FEM.PL.(NOM) sailor.PL.(ACC) attentively
anhören, und Wiebke beobachtet das auch.
listen.to.3PL and Wiebke observes that too
Richard observes that innkeepers attentively listen to sailors, and Wiebke observes that, too.

c. Ben beobachtet, dass Wirtinnen Schilderungen aufmerksam
Ben observes that innkeeper.FEM.PL.(NOM) description.PL.(DAT) attentively
zuhören, und Nicole beobachtet das auch.
listen.to.3PL and Nicole observes that too

Ben observes that innkeepers attentively listen to descriptions, and Nicole observes that, too.

d. Anne beobachtet, dass Wirtinnen Matrosen aufmerksam
Anne observes that innkeeper.FEM.PL.(NOM) sailor.PL.(DAT) attentively
zuhören, und Dirk beobachtet das auch.
listen.to.3PL and Dirk observes that, too.
Anne observes that innkeepers attentively listen to sailors, and Dirk observes that, too.

(25) a. Martin hofft, dass Direktoren Abteilungen umsichtig anleiten,
Martin hopes that director.PL.(NOM) department.PL.(ACC) carefully guide.3PL
und Marlen hofft das auch.
and Marlen hopes that too
Martin hopes that directors carefully guide departments, and Marlen hopes so, too.

b. Monika hofft, dass Direktoren Sekretärinnen umsichtig
Monika hopes that director.PL.(NOM) secretary.FEM.PL.(ACC) carefully
anleiten, und Jürgen hofft das auch.
guide.3PL and Jürgen hopes that too
Monika hopes that directors carefully guide secretaries and Jürgen hopes so, too.

c. Judith hofft, dass Direktoren Abteilungen umsichtig
Judith hopes that director.PL.(NOM) department.PL.(DAT) carefully
vorstehen, und Melanie hofft das auch.
preside.over.3PL and Melanie hopes that too
Judith hopes that directors carefully preside over departments, and Melanie hopes so, too.

d. Barbara hofft, dass Direktoren Sekretärinnen umsichtig
Barbara hopes that director.PL.(NOM) secretary.FEM.PL.(DAT) carefully
vorstehen, und Rainer hofft das auch.
preside.over.3PL and Rainer hopes that too
Barbara hopes that directors carefully preside over secretaries, and Rainer hopes so, too.

(26) a. Nora erzählt, dass Jungen Autos neugierig anstarren, und Gabi
Nora tells that boy.PL.(NOM) car.PL.(ACC) curiously stare.at.3PL and Gabi
erzählt das gleiche.
tells the same
Nora tells that boys curiously stare at cars and Gabi tells the same.

b. Dirk erzählt, dass Jungen Mädchen neugierig anstarren, und Nicole
Dirk tells that boy.PL.(NOM) girl.PL.(ACC) curiously stare.at.3PL and Nicole
erzählt das gleiche.
tells the same.

Dirk tells that boys curiously stare at girls, and Nicole tells the same.

c. Nadine erzählt, dass Jungen Autos neugierig nachlaufen, und
Nadine tells that boy.PL.(NOM) car.PL.(DAT) curiously run.after.3PL and
Jessica erzählt das gleiche.
Jessica tells the same

Nadine tells that boys curiously run after cars, and Jessica tells the same.

d. Dieter erzählt, dass Jungen Mädchen neugierig nachlaufen, und
Dieter tells that boy.PL.(NOM) girl.PL.(DAT) curiously run.after.3PL and
Andreas erzählt das gleiche.
Andreas tells the same.

Dieter tells that boys curiously run after girls, and Andreas tells the same.

(27) a. Lena weiß, dass Kätzchen Murmeln neugierig beschnuppern,
Lena knows that cat-.DIM.PL.(NOM) marble.PL.(ACC) curiously sniff.at.3PL
und Frieda weiß das auch.
and Frieda knows that too

Lena knows that kitties curiously sniff at marbles, and Frieda knows that, too.

b. Nora weiß, dass Kätzchen Amseln neugierig beschnuppern,
Nora knows that cat-.DIM.PL.(NOM) blackbird.PL.(ACC) curiously sniff.at.3PL
und Henning weiß das auch.
and Henning knows that too

Nora knows that kitties curiously sniff at blackbirds, and Henning knows that, too.

c. Hannes weiß, dass Kätzchen Murmeln neugierig nachlaufen,
Hannes knows that cat-.DIM.PL.(NOM) marble.PL.(DAT) curiously run.after.3PL
und Holger weiß das auch.
and Holger knows that too

Hannes knows that kitties curiously run after marbles and Holger knows that, too.

d. Lisa weiß, dass Kätzchen Amseln neugierig nachlaufen,
Lisa knows that cat-.DIM.PL.(NOM) blackbird.PL.(DAT) curiously run.after.3PL
und Kilian weiß das auch.
and Kilian knows that too

Lisa knows that kitties curiously run after blackbirds, and Kilian knows that, too.

(28) a. Thomas erzählt, dass Katzen Tierparks selten akzeptieren, und Matti
Thomas tells that cat.PL.(NOM) zoo.PL.(ACC) rarely accept.3PL and Matti
erzählt das gleiche.
tells the same

Thomas tells that cats rarely accept zoos and Matti tells the same.

b. Roland erzählt, dass Katzen Frauchen selten akzeptieren, und
Roland tells that cat.PL.(NOM) woman.DIM(PL.ACC) rarely accept.3PL and
Sabine erzählt das gleiche.
Sabine tells the same

Roland tells that cats rarely accept (female) owners, and Sabine tells the same.

c. Willi erzählt, dass Katzen Tierparks selten entlaufen, und Artur
Willi tells that cat.PL.(NOM) zoo.PL.(DAT) rarely run.off.3PL and Artur
erzählt das gleiche.
tells the same.

Willi tells that cats rarely run away from zoos, and Artur tells the same.

d. Nicole erzählt, dass Katzen Frauchen selten entlaufen, und
Nicole tells that cat.PL.(NOM) woman.DIM(PL.ACC) rarely run.off.3PL and
Jens erzählt das gleiche.
Jens tells the same.

Nicole tells that cats rarely run away from (female) owners, and Jens tells the same.

(29) a. Vroni denkt, dass Wirtinnen Schankauflagen gerne
Vroni thinks that innkeeper.FEM.PL.(NOM) serving-requirement.PL.(ACC) gladly
beachten, und Kevin denkt es auch.
observe.3PL and Kevin thinks it too

Vroni thinks that innkeepers like paying attention to licensing laws, and Kevin thinks so, too.

b. Dora denkt, dass Wirtinnen Stammkunden gerne
Dora thinks, that innkeeper.FEM.PL.(NOM) stem-customer.PL.(ACC) gladly
beachten, und Mona denkt es auch.
observe.3PL and Mona thinks it too

Dora thinks that innkeepers like paying attention to regular customers, and Mona thinks so, too.

c. Christian denkt, dass Wirtinnen Schankauflagen
Christian thinks that innkeeper.FEM.PL.(NOM) serving-requirement.PL.(DAT)
gerne entgegenkommen, und Daniel denkt es auch.
gladly come.toward3PL and Daniel thinks it too

Christian thinks that innkeepers like making concessions to licensing laws, and Daniel thinks so, too.

d. Maren denkt, dass Wirtinnen Stammkunden gerne
Maren thinks that innkeeper.FEM.PL.(NOM) stem-customer.PL.(DAT) gladly
entgegenkommen, und Volker denkt es auch.
come.toward3PL and Volker thinks it too

Maren thinks that innkeepers like making concessions to regular customers, and Volker thinks so, too.

(30) a. Jana sagt, dass Schülerinnen Einladungen gerne annehmen, und
Jana says that pupil.FEM.PL.(NOM) invitiation.PL.(ACC) gladly accept.3PL and
Mirko sagt das auch.
Mirko says that too

Jana says that pupils like accepting invitations, and Mirko says so, too.

b. Matthias sagt, dass Schülerinnen Lehrerinnen gerne annehmen,
Matthias says that pupil.FEM.PL.(NOM) teacher.FEM.PL.(ACC) gladly accept.3PL
und Felix sagt das auch.
and Felix says that too

Matthias says that pupils like accepting teachers, and Felix says so, too.

c. Peter sagt, dass Schülerinnen Einladungen gerne
Peter says that pupil.FEM.PL.(NOM) invitation.PL.(DAT) gladly
entgegenkommen, und Stefan sagt das auch.
come.toward.3PL and Stefan says that too.

Peter says that pupils like to accomodate to invitations and Stefan says so, too.

d. Karl sagt, dass Schülerinnen Lehrerinnen gerne
Karls says that pupil.FEM.PL.(NOM) teacher.FEM.PL.(DAT). gladly
entgegenkommen, und Lars sagt das auch.
come.toward.3PL and Lars says that too

Karl says that pupils gladly accommodate to teachers, and Lars says so, too.

(31) a. Martin erzählt, dass Urlauberinnen Obstkarren gerne
Martin tells that tourist.FEM.PL.(NOM) fruit-cart.PL.(ACC) gladly
fotografieren, und Jörg erzählt das auch.
photograph.3PL and Jörg tells that too

Martin tells that tourists like taking photos of fruit carts, and Jörg tells that, too.

b. Otto erzählt, dass Urlauberinnen Marktfrauen gerne
Otto tells that tourist.FEM.PL.(NOM) market-woman.PL.(ACC) gladly
fotografieren, und Wiebke erzählt das auch.
photograph.3PL and Wiebke tells that too
Otto tells that tourists like taking photos of market-women, and Wiebke tells that, too.

c. Karsten erzählt, dass Urlauberinnen Obstkarren gerne winken,
Karsten tells that tourist.FEM.PL.(NOM) fruit-cart.PL.(DAT) gladly wave.3PL
und Tobias erzählt das auch.
and Tobias tells that too.
Karsten tells that tourist like waving to fruit carts, and Tobias tells that, too.

d. Joachim erzählt, dass Urlauberinnen Marktfrauen gerne
Joachim tells that tourist.FEM.PL.(NOM) market-woman.PL.(DAT) gladly
winken, und Silke erzählt das auch.
wave.3PL and Silke tells that too.
Joachim tells that tourists like waving to market-women, and Silke tells that, too.

(32) a. Lara sieht, dass Clowns Luftballons begeistert
Lara sees that clown.PL.(NOM) air-balloon.PL.(ACC) enthusiastically
fotografieren, und Tanja sieht es auch.
photograph.3PL and Tanja sees it too.
Lara sees that clowns enthusiastically take photos of balloons, and Tanja sees it, too.

b. Silke sieht, dass Clowns Elefanten begeistert
Silke sees that clown.PL.(NOM) elephant.PL.(ACC) enthusiastically
fotografieren, und Joachim sieht es auch.
photograph.3PL and Joachim sees it too
Silke sees that clowns enthusiastically take photos of elephants, and Joachim sees it, too.

c. Jörg sieht, dass Clowns Luftballons begeistert winken,
Jörg sees that clown.PL.(NOM) air-balloon.PL.(DAT) enthusiastically wave.3PL
und Volker sieht es auch.
and Volker sees it too
Jörg sees that clowns enthusiastically wave to balloons, and Volker sees it, too.

d. Malte sieht, dass Clowns Elefanten begeistert winken,
Malte sees that clown.PL.(NOM) elephant.PL.(DAT) enthusiastically wave.3PL
und Basti sieht es auch.
and Basti sees it too

Malte sees that clowns enthusiastically wave to elephants, and Basti sees it, too.

(33) a. Merle behauptet, dass Waisen Sonderschulen niemals fürchten,
Merle claims that orphan.PL.(NOM) special-school.PL.(ACC) never fear.3PL
und Wiebke behauptet das gleiche.
and Wiebke claims the same.

Merle claims that orphans never fear special schools, and Wiebke claims the same.

b. Heidi behauptet, dass Waisen Betreuerinnen niemals
Heidi claims that orphan.PL.(NOM) custodian.FEM.PL.(ACC) never
fürchten, und Greta behauptet das gleiche.
fear.3PL and Greta claims the same.

Heidi claims that orphans never fear custodians, and Greta claims the same.

c. Jutta behauptet, dass Waisen Sonderschulen niemals
Jutta claims that orphan.PL.(NOM) special-school.PL.(DAT) never
entkommen, und Roland behauptet das gleiche.
escape.3PL and Roland claims the same.

Jutta claims that orphans never escape special schools, and Roland claims the same.

d. Robert behauptet, dass Waisen Betreuerinnen niemals
Robert claims that orphan.PL.(NOM) custodian.PL.(DAT) never
entkommen, und Antje behauptet das gleiche.
escape.3PL and Antje claims the same

Robert claims that orphans never escape custodians, and Antje claims the same.

(34) a. Tina beklagt, dass Journalisten Parteien regelmäßig parodieren,
Tina laments that journalist.PL.(NOM) party.PL.(ACC) regularly parody.3PL
und Petra beklagt es auch.
and Petra laments it too

Tina laments that journalists regularly spoof [political] parties, and Petra laments it, too.

b. Hannes beklagt, dass Journalisten Kollegen regelmäßig
Hannes laments that journalist.PL.(NOM) colleague.PL.(ACC) regularly
parodieren, und Volker beklagt es auch.
parody.3PL and Volker laments it, too.

Hannes laments that journalists regularly spoof colleagues, and Volker laments it, too.

c. Wolfgang beklagt, dass Journalisten Parteien regelmäßig
Wolfgang laments that journalist.PL.(NOM) party.PL.(DAT) regularly
zuvorkommen, und Claudia beklagt es auch.
scoop.3PL and Claudia laments it too
Wolfgang laments that journalists regularly scoop [political] parties, and Claudia laments it, too.

d. Britta beklagt, dass Journalisten Kollegen regelmäßig
Britta laments that journalist.PL.(NOM) colleague.PL.(DAT) regularly
zuvorkommen, und Inge beklagt es auch.
scoop.3PL and Inge laments it too
Britta laments that journalists regularly scoop colleagues, and Inge laments it, too.

(35) a. Jonna hofft, dass Beraterinnen Parteien engagiert
Jonna hopes that consultant.FEM.PL.(NOM) party.PL.(ACC) committedly
unterstützen, und Nils hofft das auch.
support.3PL and Nils hopes that too
Jonna hopes that consultants committedly support [political] parties, and Nils hopes so, too.

b. Inge hofft, dass Beraterinnen Kandidaten engagiert
Inge hopes that consultant.FEM.PL.(NOM) candidate.PL.(ACC) committedly
unterstützen, und Michael hofft das auch.
support.3PL and Michael hopes that too
Ingo hopes that consultants committedly support candidates, and Michael hopes so, too.

c. Britta hofft, dass Beraterinnen Parteien engagiert
Britta hopes that consultant.FEM.PL.(NOM) party.PL.(DAT) committedly
dienen, und Jannis hofft das auch.
serve.3PL and Jannis hopes that too
Britta hopes that consultants committedly serve [political] parties, and Jannis hopes so, too.

d. Joachim hofft, dass Beraterinnen Kandidaten engagiert
Joachim hopes that consultant.FEM.PL.(NOM) candidate.PL.(DAT) committedly
dienen, und Marion hofft das auch.
serve.3PL and Marion hopes that too.
Joachim hopes that consultants committedly serve candidates, and Marion hopes so, too.

(36) a. Lily sagt, dass Patienten Anweisungen ungern missachten,
Lily says that patient.PL.(NOM) instruction.PL.(ACC) reluctantly disobey.3PL
und Emma sagt das gleiche.
and Emma says the same
Lily says that patients are reluctant to disobey instructions, and Emma says so, too.

b. Helene sagt, dass Patienten Ärztinnen ungern missachten,
Helene says that patient.PL.(NOM) doctor.FEM.PL.(ACC) reluctantly disobey
und Simon sagt das gleiche.
and Simon says the same
Helene says that patients are reluctant to disobey doctors, and Simon says so, too.

c. Janne sagt, dass Patienten Anweisungen ungern gehorchen,
Janne says that patient.PL.(NOM) instruction.PL.(DAT) reluctantly obey
und Ingo sagt das gleiche.
and Ingo says the same
Janne says that patients are reluctant to obey instructions, and Ingo says so, too.

d. Silke sagt, dass Patienten Ärztinnen ungern gehorchen,
Silke says that patient.PL.(NOM) doctor.FEM.PL.(DAT) reluctantly obey
und Wolfgang sagt das gleiche.
and Wolfgang says the same
Silke says that patients are reluctant to obey doctors, and Wolfgang says so, too.

(37) a. Vera glaubt, dass Fußballfans Sportsendungen ungeduldig
Vera believes that football-fan.PL.(NOM) sport-broadcast.PL.(ACC) impatiently
herbeisehnen, und Kai glaubt es auch.
yearn.for.3PL and Kai believes it too
Very believes that football fans impatiently yearn for sports programmes, and Kai believes so, too.

b. Ingo glaubt, dass Fußballfans Schiedsrichterinnen ungeduldig
Ingo believes that football-fan.PL.(NOM) referee.FEM.PL.(ACC) impatiently
herbeisehnen, und Dan glaubt es auch.
yearn.for.3PL and Dan believes it too
Ingo believes that football fans impatiently yearn for referees, and Dan believes so, too.

c. Nadia glaubt, dass Fußballfans Sportsendungen ungeduldig
Nadia believes that football-fan.PL.(NOM) sport-broadcast.PL.(DAT) impatiently
entgegenfiebern, und Mara glaubt es auch.
fever.toward.3PL and Mara believes it too

Nadia believes that football fans impatiently look forward to sports programmes, and Mara believes so, too.

d. Leo glaubt, dass Fußballfans Schiedsrichterinnen ungeduldig
Leo believes that football-fan.PL.(NOM) referee.FEM.PL.(DAT) impatiently
entgegenfiebern, und Niki glaubt es auch.
fever.toward.3PL and Niki believes it too
Leo believes that football fans impatiently look forward to referees, and Niki believes it, too.

(38) a. Markus findet, dass Menschen Maschinen irgendwie mögen, und
Markus thinks that human.PL.(NOM) machine.PL.(ACC) somehow like.3PL and
Nina findet das auch.
Nina thinks that too
Markus thinks that humans kind of like machines, and Nina thinks so, too.

b. Roland findet, dass Menschen Affen irgendwie mögen, und
Roland thinks that human.PL.(NOM) monkey.PL.(ACC) somehow like.3PL and
Martin findet das auch.
Martin thinks so too
Roland thinks that humans kind of like monkeys and Martin thinks so, too.

c. Silke findet, dass Menschen Maschinen irgendwie ähneln, und
Silke thinks that human.PL.(NOM) machine.PL.(DAT) somehow resemble.3PL and
Astrid findet das auch.
Astrid thinks that too
Silke thinks that humans somehow resemble machines, and Astrid thinks so, too.

d. Bert findet, dass Menschen Affen irgendwie ähneln, und
Bert thinks that human.PL.(NOM) monkey.PL.(DAT) somehow resemble.3PL and
Ingo findet das auch.
Ingo thinks that too
Bert thinks that humans somehow resemble monkeys, and Ingo thinks so, too.

(39) a. Florian sagt, dass Demonstranten Polizeiwagen stundenlang
Florian says that protester.PL.(DAT) police-van.PL.(ACC) hour-long
beobachten, und Julia sagt das auch.
observe.3PL and Julia says that too.
Florian says that protesters observe police vans for hours, and Julia says so, too.

b. Felix sagt, dass Demonstranten Polizistinnen stundenlang beobachten,
Felix says that protester.PL.(NOM) police.FEM.PL.(ACC) hour-long observe.3PL
und Lisa sagt das auch.
and Lisa says that too

Felix says that protesters observe policewomen for hours, and Lisa says so, too.

c. Lukas sagt, dass Demonstranten Polizeiwagen stundenlang
Lukas says that protester.PL.(NOM) police-van.PL.(DAT) hour-long
gegenüberstehen, und Tanja sagt das auch.
stand.opposite.3PL and Tanja says that too

Lukas says that protesters face policevans for hours, and Tanja says so, too.

d. Tim sagt, dass Demonstranten Polizistinnen stundenlang
Tim says that protester.PL.(NOM) policeman.FEM.PL.(DAT) hour-long
gegenüberstehen, und Björn sagt das auch.
stand.opposite.3PL and Björn says that too

Tim says that protesters face policewomen for hours, and Björn says so, too.

(40) a. Katja weiß, dass Mädchen Erinnerungen jahrelang verschweigen, und
Katja knows that girl.PL.(NOM) memory-PL.(ACC) years-long keep.quiet.3PL and
Nina weiß es auch.
Nina knows it, too.

Katja knows that girls keep quiet about memories for years, and Nina knows it, too.

b. Astrid weiß, dass Mädchen Freundinnen jahrelang verschweigen,
Astrid knows that girl.PL.(NOM) friend.FEM.PL.(ACC) years-long keep.quiet.3PL
und Silke weiß es auch.
and Silke knows it, too.

Astrid knows that girls keep quiet about friends for years, and Nina knows it, too.

c. Bert weiß, dass Mädchen Erinnerungen jahrelang nachtrauern, und
Bert knows that girl.PL.(NOM) memory.PL.(DAT) years-long mourn.after.3PL and
Jens weiß es auch.
Jens knows it too

Bert knows that girls mourn memories for years, and Jens knows it, too.

d. Ronnie weiß, dass Mädchen Freundinnen jahrelang nachtrauern,
Ronnie knows that girl.PL.(NOM) friend.FEM.PL.(DAT) years-long mourn.after.3PL
und Mandy weiß es auch.
and Mandy knows it too

Ronnie knows that girls mourn friends for years, and Mandy knows it, too.

(41) a. Pit berichtet, dass Matrosen Schlechtwetterfronten ausdauernd
Pit reports that sailor.PL.(NOM) bad-weather-front.PL.(ACC) enduringly
abwehren, und Isa berichtet das auch.
off.ward.3PL and Isa reports that too
Pit reports that sailors enduringly ward off bad weather, and Isa reports that, too.

b. Simon berichtet, dass Matrosen Piraten ausdauernd abwehren,
Simon reports that sailor.PL.(NOM) pirate.PL.(ACC) enduringly off.ward.3PL
und Jonas berichtet das auch.
and Jonas reports that too
Simon reports that sailors enduringly ward off pirates, and Jonas reports that, too.

c. Ulf berichtet, dass Matrosen Schlechtwetterfronten ausdauernd
Ulf reports that sailor.PL.(NOM) bad-weather-front.PL.(DAT).PL enduringly
trotzen, und Nina berichtet das auch.
defy.3PL and Nina reports that too
Ulf reports that sailors enduringly defy bad weather, and Nina reports that, too.

d. Maja berichtet, dass Matrosen Piraten ausdauernd trotzen, und
Maja reports that sailor.PL.(NOM) pirate.PL.(DAT) enduringly defy.3PL and
Kati berichtet das gleiche.
Kati reports that too
Maja reports that sailors enduringly defy pirates, and Kati reports that, too.

(42) a. Mellie kritisiert, dass Eltern Anschuldigungen zögerlich
Melli criticizes, that parent.PL.(NOM) accusation.PL.(ACC) hesitantly
anerkennen, und Basti kritisiert das auch. .
recognize.3PL and Basti criticizes that too
Melli criticizes that parents hesitantly recognize accusations, and Basti criticizes that, too.

b. Christian kritisiert, dass Eltern Lehrerinnen zögerlich
Christian criticizes that parent.PL.(NOM) teacher.PL.(ACC) hesitantly
anerkennen, und Birte kritisiert das auch.
recognize and Birte criticizes that too
Christian criticizes that parents hesitantly recognize teachers, and Birte criticizes that, too.

c. Anne kritisiert, dass Eltern Anschuldigungen zögerlich
Anne criticizes that parent.PL.(NOM) accusation.PL.(DAT) hesitantly
beipflichten, und Flo kritisiert das auch.
assent.to.3PL and Flo criticizes that too

Anne criticizes that parents hesitantly assent to accusations, and Flo criticizes that, too.

d. Andi kritisiert, dass Eltern Lehrerinnen zögerlich
Andi criticizes that parent.PL.(NOM) teacher.FEM.PL.(DAT) hesitantly
beipflichten, und Robert kritisiert das auch.
assent.to.3PL and Robert criticizes that too
Andi criticizes that parents hesitantly assent to teachers, and Robert criticizes that, too.

(43) a. Mirko bedauert, dass Direktoren Abteilungen unverhohlen
Mirko regrets that director.PL.(NOM) department.PL.(ACC) blatantly
bedrohen, und Sven bedauert es auch.
threaten and Sven regrets it, too.
Mirko regrets that directors blatantly threaten departments, and Sven regrets it, too.

b. Peter bedauert, dass Direktoren Sekretärinnen unverhohlen bedrohen,
Peter regrets that director.PL.(NOM) secretary.PL.(ACC) blatantly threaten,
und Maria bedauert es auch.
and Maria regrets it too
Peter regrets that directors blatantly threaten secretaries, and Maria regrets it, too.

c. Lars bedauert, dass Direktoren Abteilungen unverhohlen
Lars regrets that director.PL.(NOM) department.PL.(DAT) blatantly
drohen, und Jasmin bedauert es auch.
threaten.3PL and Jasmin regrets it too
Lars regrets that directors blatantly threaten departments, and Jasmin regrets it, too.

d. Jochen bedauert, dass Direktoren Sekretärinnen unverhohlen
Jochen regrets that director.PL.(NOM) secretary.FEM.PL.(DAT) blatantly
drohen, und Henning bedauert es auch.
threaten.3PL and Henning regrets it too
Jochen regrets that directors blatantly threaten secretaries, and Henning regrets it, too.

(44) a. Jasmin glaubt, dass Präsidenten Nachbarstaaten unverhohlen
Jasmin believes that president.PL.(NOM) neighbour.state.PL.(ACC) blatantly
bedrohen, und Anne glaubt es auch.
threaten.3PL and Anne believes it too

Jasmin believes that presidents blatantly threaten neighbouring countries, and Anne believes that, too.

b. Valerie glaubt, dass Präsidenten Praktikanten unverhohlen
Valerie believes that president.PL.(NOM) intern.PL.(ACC) blatantly
bedrohen, und Philipp glaubt es auch.
threaten.3PL and Philipp believes it too
Valerie believes that presidents blatantly threaten interns, and Philipp believes it, too.

c. Peter glaubt, dass Präsidenten Nachbarstaaten unverhohlen
Peter believes that president.PL.(NOM) neighbour.state.PL.(DAT) blatantly
drohen, und Maria glaubt es auch.
threaten.3PL and Maria believes it too
Peter believes that presidents blatantly threaten neighbouring countries, and Maria believes it, too.

d. Anja glaubt, dass Präsidenten Praktikanten unverhohlen drohen,
Anja believes that president.PL.(NOM) intern.PL.(DAT) blatantly threaten.3PL
und Ronnie glaubt es auch.
and Ronnie believes it too
Anja believes that presidents blatantly threaten interns, and Ronnie believes it, too.

(45) a. Ina hofft, dass Ärztinnen Versicherungen besonders
Ina hopes that doctor.FEM.PL.(NOM) insurance.PL.(ACC) specifically
empfehlen, und Pia hofft das auch.
recommend.3PL and Pia hopes that too
Pia hopes that doctors specifically recommend insurance companies, and Pia hopes that, too.

b. Ina hofft, dass Ärztinnen Krankenschwestern besonders
Ina hopes that doctor.FEM.PL.(NOM) nurse.PL.(ACC) specifically
empfehlen, und Till hofft das auch.
recommend.3PL and Till hopes that too
Ina hopes that doctors specifically recommend nurses, and Till hopes that, too.

c. Tim hofft, dass Ärztinnen Versicherungen besonders vertrauen,
Tim hopes that doctor.FEM.PL.(NOM) insurance.PL.(DAT) especially trust.3PL
und Isa hofft das auch.
and Isa hopes that too
Tim hopes that doctors especially trust insurance companies, and Isa hopes that,

too.

d. Mia hofft, dass Ärztinnen Krankenschwestern besonders vertrauen,
Mia hopes that doctor.FEM.PL.(NOM) nurse.PL.(DAT) especially trust.3PL
und Ali hofft das auch.
and Ali hopes that too
Mia hopes that doctors especially trust nurses, and Ali hopes that, too.

(46) a. Mirko glaubt, dass Mädchen Versprechungen gerne anhören, und Kati
Mirko believes that girl.PL.(NOM) promise.PL.(ACC) gladly to.listen.3PL and Kati
glaubt das auch.
believes that, too.
Mirko believes that girls like listening to promises, and Kati believes that, too.

b. Kati glaubt, dass Mädchen Lehrerinnen gerne anhören, und
Kati believes that girl.PL.(NOM) teacher.FEM.PL.(ACC) gladly to.listen.3PL and
Thorsten glaubt das auch.
Thorsten believes that too
Kati believes that girls like listening to teachers, and Thorsten believes that, too.

c. Gesine glaubt, dass Mädchen Versprechungen gerne vertrauen, und Kati
Gesine believes that girl.PL.(NOM) promise.PL.(DAT) gladly trust.3PL and Kati
glaubt das auch.
believes that too
Gesine believes that girls like trusting promises, and Kati believes that, too.

d. Andreas glaubt, dass Mädchen Lehrerinnen gerne vertrauen, und
Andreas believes that girl.PL.(NOM) teacher.FEM.PL.(DAT) gladly trust.3PL and
Thorsten glaubt das auch.
Thorsten believes that too
Andreas believes that girls like trusting teachers, and Thorsten believes that, too.

(47) a. Paula glaubt, dass Journalisten Drohungen einfach ignorieren, und
Paula believes that journalist.PL.(NOM) threat.PL.(ACC) simply ignore.3PL and
Daniel glaubt das auch.
Daniel believes that too
Paula believes that journalists simply ignore threats, and Daniel believes that, too.

b. Felix glaubt, dass Journalisten Konkurrenten einfach ignorieren,
Felix believes that journalist.PL.(NOM) competitor.PL.(ACC) simply ignore.3PL
und Dora glaubt das auch.
and Dora believes that, too.

Felix believes that journalists simply ignore competitors, and Dora believes that, too.

c. Hermann glaubt, dass Journalisten Drohungen einfach nachgeben,
Hermann believes that journalist.PL.(NOM) threat.PL.(DAT) simply give.in.to.3PL
und Inge glaubt das auch.
and Inge believes that, too.
Hermann believes that journalists simply give in to threats, and Inge believes that, too.

d. Ingo glaubt, dass Journalisten Konkurrenten einfach nachgeben,
Ingo believes that journalist.PL.(NOM) competitor.PL.(DAT) simply give.in.to.3PL
und Sabine glaubt das auch.
and Sabine believes that too
Ingo believes that journalists simply give in to competitors, and Sabine believes that, too.

(48) a. Tom vermutet, dass Politikerinnen Entwicklungen heimlich
Tom suspects that politician.FEM.PL.(NOM) development.PL.(DAT) secretly
ausspionieren, und Till vermutet das auch.
out-spy.3PL and Till suspects that too
Tom suspects that politicians secretly spy on developments, and Till suspects that, too.

b. Paula vermutet, dass Politikerinnen Kolleginnen heimlich
Paula suspects that politician.FEM.PL.(NOM) colleague.FEM.PL.(ACC) secretly
ausspionieren, und Dan vermutet das auch.
out-spy.3PL and Dan suspects that too
Paula suspects that politicians secretly spy on colleagues, and Dan suspects that, too.

c. Horst vermutet, dass Politikerinnen Entwicklungen heimlich
Horst suspects that politician.FEM.PL.(NOM) development.PL.(DAT) secretly
nachhelfen, und Karin vermutet das auch.
help.along.3PL and Karin suspects that too
Horst suspects that politicians secretly help along developments, and Karin suspects that, too.

d. Marion vermutet, dass Politikerinnen Kolleginnen heimlich
Marion suspects that politician.FEM.PL.(NOM) colleague.FEM.PL.(DAT) secretly
nachhelfen, und Vera vermutet das auch.
help.along.3PL and Vera suspects that too

Marion suspects that politicians secretly help along colleagues, and Vera suspects that, too.

(49) a. Horst glaubt, dass Rockstars Sekten gründlich verabscheuen,
Horst believes that rockstar.PL.(NOM) cult.PL.(ACC) thoroughly despise.3PL
und Schorsch glaubt das gleiche.
and Schorsch believes the same
Horst believes that rockstars thoroughly despise cults, and Schorsch believes the same.

b. Dieter glaubt, dass Rockstars Gurus gründlich verabscheuen,
Dieter believes that rockstar.PL.(NOM) guru.PL.(ACC) thoroughly despise.3PL
und Sabrina glaubt das gleiche.
and Sabrina believes the same
Dieter believes that rockstars thoroughly despise gurus, and Sabrina believes the same.

c. Petra glaubt, dass Rockstars Sekten gründlich verfallen, und
Petra believes that rockstar.PL.(NOM) cult.PL.(DAT) thoroughly fall.for.3PL and
Heidi glaubt das gleiche.
Heidi believes the same
Petra believes that rockstars thoroughly fall for cults, and Heidi believes the same.

d. Maria glaubt, dass Rockstars Gurus gründlich verfallen, und
Maria believes that rockstar.PL.(NOM) guru.PL.(DAT) thoroughly fall.for.3PL and
Hans glaubt das gleiche.
Hans believes the same
Maria believes that rockstars thoroughly fall for gurus, and Hans believes the same.

(50) a. Vera sagt, dass Millionenerben Drogen selten kennenlernen, und
Vera says that million.heir.PL.(NOM) drug.PL.(ACC) rarely get.to.know.3PL and
Peter sagt das gleiche.
Peter says the same.
Vera says that heirs of millionaires rarely get to know drugs, and Peter says the same.

b. Fritz sagt, dass Millionenerben Schauspielerinnen selten kennenlernen,
Fritz says that million.heir.PL.(NOM) actor.FEM.PL.(ACC) rarely get.to.know,
und Maria sagt das gleiche.
and Maria says the same
Fritz says that heirs of millionaires rarely get to know actresses, and Maria says the same.

c. Jakob sagt, dass Millionenerben Drogen selten erliegen, und
Jakob says that million.heir.PL.(NOM) drug.PL.(DAT) rarely succumb.to.3PL and
Max sagt das gleiche.
Max says the same

Jakob says that heirs of millionaires rarely succumb to drugs, and Max says the same.

d. Sabine sagt, dass Millionenerben Schauspielerinnen selten
Sabine says that million.heir.PL.(NOM) actor.FEM.PL.(DAT) rarely
erliegen, und Christine sagt das gleiche.
succumb.to.3PL and Christine says that too

Sabine says that heirs of millionaires rarely succumb to actresses, and Christine says so, too.

Appendix 2: Results of statistical evaluations

Self-paced reading time study

	subject		object		adverb		verb		und	
factor	F_1 (1,29)	F_2 (1,49)	F_1 (1,29)	F_2 (1,49)	F_1 (1,29)	F_2 (1,49)	F_1 (1,29)	F_2 (1,49)	F_1 (1,29)	F_2 (1,49)
anim	1.84	1.864	4.268*	0.953	14.34***	20.88***	10.42**	22.52***	3.995.	1.943
dat	0.066	0.001	0.426	0.138	0.035	0.008	2.681	1.299	2.17	0.906
anim*dat	1.214	0.948	2.605	1.869	0.457	0.126	0.599	0.018	3.681.	9.954**
s.m.e. acc									8.43**	11.69**
s.m.e. dat									0.421	0.981

Table 1: Statistical values for the self-paced reading time study (Experiment 1) described in Chapter 3. Values are given for logarithmised mean reading times of all five relevant word positions. s.m.e. = simple main effects, resolved for interactions reaching at least marginal significance. Significance codes are: '***' ($p < 0$), '**' ($p < 0.001$), '*' ($p < 0.01$), '.' ($p < 0.1$)

Eyetracking studies

Eye movements in natural reading: Unnormalised data

		subject		object		adverb		verb	
		F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)
First pass time	anim	0.37	0.69	7.05*	4.09*	3.22 .	1.36	0.15	0.18
	dat	0.38	0.86	0.04	0.14	3.42 .	2.92 .	2.15	0.76
	anim*dat	0.72	0.63	0.08	0.01	3.44.	4.03 .	0.45	0.88
	s.m.e. acc					7.63**	4.62*		
	s.m.e. dat					0	0.31		
Regression path duration	anim	0.24	0.65	2.09	1.44	8.44**	4.33*	21.33***	15.51***
	dat	0.12	0.07	0.02	0.32	0.37	0.00	12.69***	16.8***
	anim*dat	0.34	0.37	0.10	0.52	0.66	0.56	0.05	0.60
	s.m.e. acc								
	s.m.e. dat								
Total reading time	anim	14.27***	15.75***	0.16	0.22	8.75**	4.81*	3.31 .	3.63
	dat	2.57	3.65 .	1.62	0.16	0.51	2.49	12.77***	8.02**
	anim*dat	2.84 .	3.22 .	0.09	0.01	1.18	0.80	0.15	0.02
	s.m.e. acc	3.71 .	4.13*						
	s.m.e. dat	14.49***	16.61***						

Table 2: Statistical values for the eyetracking study on natural reading (Experiment 2.1), described in Chapter 4.1. Values are given for logarithmised mean reading times. s.m.e. = simple main effects, resolved for interactions reaching at least marginal significance. Significance codes are: '***' ($p < 0$), '**' ($p < 0.001$), '*' ($p < 0.01$), '.' ($p < 0.1$)

Eye movements in natural reading: Normalised data

		subject		object		adverb		verb	
		F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)
first pass time	anim	0.06	0.03	14.96***	7.54**	0.84	0.66	0.23	0.47
	dat	0.51	0.56	0.19	0.30	6.24*	4.93*	0.67	0.04
	anim*dat	0.01	0	0.16	0.45	6.29*	6.23*	0.14	0.00
	s.m.e. acc					6.15*	5.06*		
	s.m.e. dat					1.22	0.74		
regression path duration	anim	0.04	0.00	5.42*	2.79	3.81 .	2.47	13.53***	6.66*
	dat	0.74	0.24	0.24	0.18	2.14	1.62	8.90**	10.09**
	anim*dat	0.74	0.30	0.27	0.07	3.02 .	0.74	1.50	3.08 .
	s.m.e. acc					9.75**			
	s.m.e. dat					2.81 .			
total reading time	anim	11.39**	15.75***	2.13	1.69	8.10**	6.29*	2.75	1.17
	dat	4.96*	3.65 .	4.33*	3.38 .	0.00	0.03	12.47***	7.07*
	anim*dat	0.02	3.22 .	0.58	0.67	6.68*	2.92 .	0.38	0.52
	s.m.e. acc		8.17**			13.27***	9.35**		
	s.m.e. dat		10.62**			0.41	0.76		

Table 3: Statistical values for the eyetracking study on natural reading (Experiment 2.1), described in Chapter 4.1. Values are given for logarithmised mean normalised reading times. s.m.e. = simple main effects, resolved for interactions reaching at least marginal significance. Significance codes are: '***' ($p < 0$), '**' ($p < 0.001$), '*' ($p < 0.01$), '.' ($p < 0.1$)

Eye movements in boundary paradigm: Unnormalised data

		subject		object		adverb		verb	
		F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)
first pass time	anim	0.11	0.02	10.01**	8.51**	2.24	2.11	0.79	0.78
	dat	0.55	0.16	0.77	0.21	0.71	0.76	7.52**	4.0 .
	anim*dat	0.07	0.25	0.18	0.06	0.79	1.12	0.01	0.31
regression path duration	anim	1.02	0.50	7.49**	3.68 .	0.26	0.42	0.04	0.39
	dat	0.03	0.12	1.26	0.08	0.13	0.36	1.58	0.03
	anim*dat	0.35	0.01	0.48	0.33	0.17	0.39	0.20	0.38
total reading time	anim	9.70**	5.17*	0	0.01	13.74***	10.42**	6.54*	3.84 .
	dat	0.94	0.76	1.13	0.88	0.77	0.50	6.86*	2.65
	anim*dat	1.52	2.02	0.21	0.26	0.09	1.90	0.03	0.15

Table 4: Statistical values for the eyetracking study using a boundary paradigm (Experiment 2.2), described in Chapter 4.2. Values are given for logarithmised mean reading times. s.m.e. = simple main effects, resolved for interactions reaching at least marginal significance. Significance codes are: '***' ($p < 0$), '**' ($p < 0.001$), '*' ($p < 0.01$), '.' ($p < 0.1$)

Eye movements in boundary paradigm: Unnormalised data

		subject		object		adverb		verb	
		F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)	F_1 (1,51)	F_2 (1,49)
first pass time	anim	4.15*	1.67	18.68***	11.48**	0.01	0.18	0.31	0.01
	dat	2.75	2.43	0.00	0.01	0	0.01	1.46	0.52
	anim*dat	0.07	0.01	0.68	0.12	1.09	1.97	0.04	0.23
regression path duration	anim	9.67**	4.53*	14.45***	8.71**	0.45	0.00	0.60	0.42
	dat	1.27	0.36	0.05	0.00	2.43	2.01	0.54	0.42
	anim*dat	0.79	0.01	1.31	0.52	0.58	1.69	0.07	0.42
total reading time	anim	3.13 .	2.92 .	1.84	1.78	7.91**	5.45 *	1.85	1.48
	dat	0.64	0.25	0.00	0.00	0.00	0.13	2.53	1.14
	anim*dat	1.63	2.74	1.12	0.39	0.52	1.90	0.06	0.05

Table 5: Statistical values for the eyetracking study using a boundary paradigm (Experiment 2.2), described in Chapter 4.2. Values are given for logarithmised mean normalised reading times. s.m.e. = simple main effects, resolved for interactions reaching at least marginal significance. Significance codes are: '***' ($p < 0$), '**' ($p < 0.001$), '*' ($p < 0.01$), '.' ($p < 0.1$)